

FLIGHT INTERNATIONAL

Forecasts

What the next
year could
bring



Return of the Max

Can troubled twinjet regain momentum? **p6**

How Udvar-Hazy
sees recovery **p32**

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Healthy appetite
Embraer bosses
still hungry for
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Better days?

The pandemic had a devastating impact in the year just gone, and 2021 might not have too much cheer held in store either



Long-haul slog

Attempting to predict the future is a fool's game, as the emergence of a global pandemic with staggering health, social and economic consequences illustrated during what was a truly dreadful 2020.

Scroll back exactly one year, and our main Comment article – devoted to Boeing's woes with the then-grounded 737 Max – used the headline 'Annus terribilis'. Little did we know what was to come...

Indeed, an accompanying article named 'What a year' noted falling commercial orders, and offered this sage wisdom: "Look back to the Great Financial Crisis of 2008–2009; in geo-economic terms it does not get worse than that."

The reality of the coronavirus spread saw airlines around the world ground entire fleets, and some carriers shutter their operations permanently. Long-haul business disappeared almost entirely, leading to Airbus A380s and Boeing 747-400s heading for long-term storage or the breakers' yard.

We enter 2021 with recent optimism about the availability of newly approved vaccines and their promise of a return to some sort of "normal" threatened by a new and more transmissible strain of

coronavirus. Earlier optimistic forecasts of air travel returning to perhaps 75% of pre-pandemic levels by mid-year now feel like fantasy, as many wary travellers are likely to be considering the health benefits of planning a second summer "staycation" in succession.

Covid-19 aside, the coming year is already full of uncertainty. Can a returning 737 Max earn the confidence of regulators around the globe, and – just as importantly – of the travelling public? Will a simmering trade war between China and the USA erupt and restrict the sale of Western jets to Beijing's carriers? And what chaos might await regarding the UK's trade relations with the EU, and Brexit's implications for the nation's airlines?

Add to this list the as-yet unknown policy decisions of a new US administration under President-elect Joe Biden, and what actions might be taken during Donald Trump's last days in office, and 2021 already feels fraught with risk.

Should this pessimism prove ill-founded, there also is a very real chance that more airlines in Europe and further afield could go bust in a post-pandemic age, once the state aid that they currently rely on is withdrawn.

But, while many of us have not set foot inside an airliner since the coronavirus changed our lives, the crucial role of aviation during the crisis has been clear for all to see. From repatriating sick and stranded passengers to flying vitally needed supplies of personal protective equipment boxed and stacked on passenger seats under cargo nets, and keeping global trade flowing, aircraft have been and remain vital assets.

And, if one small positive can be taken from 2020's turmoil, it is that airlines and manufacturers alike – partly thanks to the insistence of governments – have finally taken seriously the environmental agenda and are actively pursuing new propulsion systems. We can expect hybrid-electric designs to make rapid progress over the next few years, while the industry pursues more promising zero-emissions technologies such as hydrogen fuel for a next generation of products – as notably backed by Airbus in 2020.

In all likelihood, we should be prepared for things to get worse before a recovery comes. So, charge your glasses – whether they be half-full or half-empty – and let's go again, into the unknown. 

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Andre Penner/AP/Shutterstock



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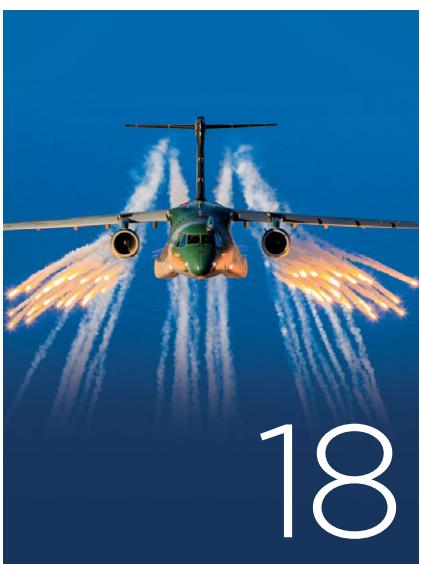
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Gol flies first as Ryanair backs Max

Boeing's troubled 737 is operating again and has scored an important sales win – but it still has challenges to overcome

Jon Hemmerdinger Tampa

Brazilian airline Gol beat everyone to the punch when it resumed flights with the Boeing 737 Max on 9 December from São Paulo, one week after the country lifted the type's grounding, and weeks ahead of much larger US carriers.

Gol was expecting its entire complement of seven Max to be cleared to fly by year-end. Its Max re-introduction was followed by Aeroméxico on 21 December, which operated a domestic service from Mexico City to Cancun.

Gol's move came after Brazil rescinded the type's grounding on 25 November, several days after the US Federal Aviation Administration (FAA) lifted its prohibition, on 18 November.

The restart of revenue services with the narrowbody seems to mark a major turning point for both Boeing and the world's 737 Max operators. Finally, the jet is back in the skies, flying passengers again after being grounded in March 2019 following two crashes that killed a combined 346 people.

Those events opened a chapter in Boeing's history that it would likely prefer to forget, but from which it pledges to learn: a seemingly endless stream of bad news, allegations of corporate malfeasance and of browbeating the FAA, and public chastising before the US Congress.

Boeing has taken responsibil-

ity for its role in designing the flight-control software that, in failing, effectively triggered the incidents that doomed 737 Max 8s operated by Indonesia's Lion Air and Ethiopian Airlines.

The airframer and the FAA insist that all the Max's safety concerns have been addressed; the Max has been made at least as safe as any commercial aircraft in the skies, they argue.

US carriers are lining up to get the Max airborne, with American Airlines leading the charge. American plans to resume Max operations on 29 December with a flight from Miami to New York LaGuardia.

Passenger concerns

Next up in the USA is United Airlines, which intends to operate its first post-grounding Max flights from Houston and Denver on 11 February. But in a sop to those passengers still wary of the Boeing narrowbody, United will also deploy other aircraft types on the initial routes for the Max, enabling customers to be shifted as required.

Southwest Airlines, meanwhile, says it intends to begin flights with the re-engined twinjet in March.

But given the concerns about the FAA's certification processes that the Max episode has generated in regulators across the globe, it comes as little surprise that other jurisdictions are taking longer to re-approve the aircraft.

Canada on 18 December said it had "validated" Boeing's changes

to the Max and related pilot training updates. Although Transport Canada has not yet cleared the jet to fly, that seems likely in January, when the agency says it will issue the required airworthiness directive.

That order will include Canada-specific requirements. The agency says it will require that pilots be able to disable the jet's stick-shaker when erroneously activated by an angle-of-attack sensor.

"This feature will help to reduce pilot workload, given what has been learned from the two tragic accidents, and has been fully evaluated by Transport Canada's flight-test pilots," the agency says. "There will also be differences in training, including training on the enhanced flight-deck procedure."

Meanwhile, the European Union Aviation Safety Agency has indicated it will lift the Max's grounding in mid-January.

But one wildcard remains: China. Analysts have little clarity on when that country, home to many 737 Max customers, might clear the jet. And they see the process as entangled with the US-China trade war and Beijing's interest in promoting its homegrown competitor, the in-development Comac C919.

Chinese approval is critical for Boeing, as the nation's carriers potentially account for some 30% of future Max deliveries, Air Lease executive chairman Steven Udvar-Hazy has said.

On 8 December, Boeing also kicked off the long process of



André Penner/AP/Shutterstock

First revenue flight after recertification was on 9 December from São Paulo

delivering the roughly 450 737 Max that it has manufactured, then stockpiled, amid the grounding. The first example went to United.

The delivery process faces complications because of the pandemic, which has left many carriers unwilling or unable to take the new jets. But Boeing needs to get those aircraft out the door as the company badly needs the cash that comes from delivery.

Programme victory

Despite those difficulties, Boeing scored a victory for the programme just days after the FAA lifted the Max grounding.

On 3 December, Irish discount carrier Ryanair ordered 75 additional 737 Max, adding to the 135 it already had already committed to. That was followed on 22 December by Alaska Airlines, which ordered an additional 23 737-9s, taking to 120 the carrier's orders and options for the Max.

"We believe in this airplane, we believe in our strong partnership with Boeing, and we believe in the future of Alaska Airlines," says group chief executive Brad Tilden, eyeing the post-pandemic market.

What became apparent with both orders, though, is that Boeing has no intention of dropping the Max name, despite some carriers removing that designation from their own communications.

"There is no rebranding going on," stresses the airframer's chief executive David Calhoun. ▶

Pilots 'coached' to fit assumptions on MCAS reaction time

David Kaminski-Morrow London

US Senate committee investigators believe Boeing and the US Federal Aviation Administration (FAA) tried to reaffirm controversial assumptions over pilot response times during 737 Max recertification, by pre-determining the outcome of tests on crew reactions to a runaway stabiliser.

The Senate committee on commerce, science and transportation has found that Boeing "inappropriately coached" test pilots while conducting simulator tests during recertification of the Max, after two fatal accidents involving the type.

Both accidents were linked to the Maneuvering Characteristics Augmentation System (MCAS) software, which erroneously trimmed the horizontal stabiliser to push the aircraft into a nose-down attitude. Investigators probing one of the accidents, involving a Lion Air 737 Max, said Boeing had incorrectly predicted the manner in which pilots would react to a series of false MCAS activations.

The Senate committee's newly published report states that Boeing assumes a 4s reaction time for a pilot to identify and begin correcting a runaway stabiliser, through memory.

But the committee adds that, according to a whistleblower serving as an FAA aviation safety inspector, this "long-assumed" reaction time is "not realistic".

The whistleblower alleged that Boeing officials were present during 737 Max runaway stabiliser reaction tests conducted in 2019 with an FAA Aircraft Certification Office test pilot and an Aircraft Evaluation Group test pilot.

Boeing officials are alleged, says the committee, to have "encouraged" the test pilots to remember to activate the stabiliser trim control switches straight away, enabling them to counter actions from MCAS. This amounted to coaching of the test pilots, the committee concludes, "contrary to testing protocol".

Based on corroborated whistleblower information and interview testimony, the committee adds, Boeing and FAA officials who were involved in the conduct of this test "established a predetermined outcome to reaffirm a long-held human factor assumption" relating to pilot reaction time to stabiliser runaway.

The whistleblower claims the Aircraft Evaluation Group pilot – who participated only after a second Aircraft Certification Office pilot became unavailable – took 16s to react to the runaway stabiliser, some four times longer than the 4s assumption.

Such was their concern that the whistleblower, in July 2019, carried out and shared the results of an ad hoc experiment to "spot-check" some volunteer Southwest Airlines 737 crews.

This experiment was intended to explore any "potential discrepancy" between these pilots' responses to a runaway stabiliser, through the commonly used quick-reference card system, and the memory-item approach applied by Boeing.

While the whistleblower acknowledges that the experiment – conducted with three crews and a 737NG simulator – was not statistically adequate, the results pointed to a lagged response time, between 7s and 11s, in recognising the stabiliser runaway. Executing the quick-reference card procedure took 49-62s.

"One reason line crews do not respond as Boeing expects is that they are used to the trim wheel moving by [the speed-trim system]," the whistleblower stated in an August 2019 communication detailing the results of the experiment to the Aircraft Evaluation Group.

The Senate committee report covers a wide range of issues relating to oversight, beyond those affecting the 737 Max.

The FAA is reviewing the document. Boeing has offered a non-combative response to the Senate findings, simply stating that it takes the conclusions "seriously" and will "continue to review the report in full".

Crashed PIA ATR 42 stalled and inverted after powerplant failure

Fractured turbine blade led to loss of power, high drag levels and rapid descent, leaving crew unable to control aircraft

David Kaminski-Morrow London

Investigators have determined that the complex failure of a Pakistan International Airlines (PIA) ATR 42-500's left-hand engine preceded a loss of control that developed into a stall, loss of altitude, and eventual fatal collision with terrain.

At one point in the accident sequence the aircraft inverted as it underwent a full 360° roll to the right, continuing to roll another 90° before banking left until it was wings-level – losing some 5,100ft in height overall.

The ATR (AP-BHO) had been operating from Chitral to Islamabad on 7 December 2016, its sixth flight of the day, with 42 passengers and a crew of five.

Pakistan's aircraft accident investigation board says the aircraft probably took off with a fractured stage-one power turbine blade in its left-hand Pratt & Whitney Canada PW127E powerplant.

Investigators believe the blade "probably" fractured or dislodged during the previous flight, from Peshawar to Chitral.

The engine had been installed three weeks earlier, having been taken from another of PIA's ATRs (AP-BHP) during unscheduled maintenance. During this work the power turbine assembly was removed.

Replacement criteria

But while the turbine blades had passed the 10,000h criteria for replacement, the inquiry says they "were not replaced". The engine operated for a further 93h before the onset of the emergency.

Over the initial 26min of the flight to Islamabad – with the ATR cruising at 13,500ft – there was evidence that the left-hand propeller's speed-governing accuracy had degraded, but this was not noticed by the crew. The aircraft was cruising at 186kt (344km/h) instead of the expected 230kt.

The inquiry says a series of technical malfunctions then occurred to the engine and its propeller control system.

Fracture of the turbine blade unbalanced the power turbine, and the situation was complicated by another latent problem, a broken pin in the engine's overspeed governor, as well as oil contamination.

The resulting technical malfunction generated an increase in propeller pitch and an unusual decline in propeller speed – from the cruise level of 82% it fell to 62%.

"Due to this combined technical anomaly, during following parts of the flight, the conditions were exceptionally difficult," says the inquiry, pointing out that the aircraft suffered "uncontrolled variation" in its propeller speed and blade pitch.

93h

Flight time in excess of 10,000h limit for failed stage one turbine blade

Propeller speed increased to 102%, before falling, while the blade pitch reached a point possibly close to the feather position. The propeller speed unexpectedly increased again, corresponding to an unfeathering, reaching 120-125%.

The left side of the aircraft produced "high drag values", says the inquiry, while the crew had not responded with sufficient power, resulting in falling airspeed and the aircraft flying on the verge of stalling, its stick-shaker activating.

Advancement of power on the right-hand engine, it says, coupled with "excessive" right rudder to counter the asymmetric condition, coincided with an "abrupt" fall in the left-hand propeller speed.

"A considerable amount of drag was eliminated from the left side of the aircraft," says the inquiry, and

the crew's efforts to maintain directional control suddenly became "surplus to the requirement" – resulting in a sharp yaw to the right, the inverting roll and rapid descent, the aircraft losing 5,100ft before recovering at 8,350ft.

Psychological impact

"This had immense psychological impact on the cockpit crew, and it impaired their capacity to perform normally," says the inquiry.

After the recovery, complex simulations indicate the aircraft's propeller blades might have settled at a low pitch while rotating at about 5%, generating stable drag forces on the left side.

But the aircraft's behaviour differed from what would be expected during a standard in-flight shutdown and single-engined operation, with propeller drag some seven times more than it would normally produce once feathered. "In this degraded condition it was not possible for the aircraft to maintain a level flight," says the inquiry. It could only fly in a gradual descent of 800-1,000ft/min at around 150-160kt.

Directional control was possible with "substantial" right rudder and right aileron inputs, it adds, but the pilots were "unable to judge" the nature and extent of degradation in the aircraft's aerodynamic performance. When the crew attempted to reduce the rate of descent, the airspeed also began to fall.

Despite progressively-increasing control inputs to the right, the aircraft entered a continuous left turn, approaching high terrain and triggering ground-proximity warnings. The airspeed declined and the aircraft stalled at 4,280ft – just 850ft above ground – rolling 90° to the left and pitching 23° nose-down before striking a mountain base 42min into its flight.

None of the occupants survived the impact, 24nm (45km) north of Islamabad airport and 3.5nm south-southeast of Havelian. ▶



Sultan Dogar/EPA/Shutterstock

Turboprop crashed 42min into flight, killing all 47 passengers and crew

Investigation highlights 'significantly lower' engine reliability on flag carrier's ATR fleet

Engine reliability on the ATR fleet of Pakistan International Airlines (PIA) was "significantly lower" than the global average, investigators have revealed.

Pakistan's aircraft accident investigation board says engine manufacturer Pratt & Whitney Canada provided data to the inquiry comparing the reliability of PIA's PW127s with that of the worldwide ATR fleet.

The analysis looked at rates of in-flight shutdown, inability to modulate power, aborted take-offs and other occurrences.

"PIA fleet engine reliability was found to be significantly lower than that of other fleets around the world," says the inquiry. "This remains true even when comparing with operators in similar operating environments."

The manufacturer had been working with the carrier to identify the reasons for this unreliability, relaying findings such as oil filter maintenance practices and corrective repair shop actions to the carrier.

Investigators found that a number of latent technical issues had been present in the ill-fated ATR 42-500's left-hand engine before the failure.

P&WC carried out a survey of PIA's engine maintenance facility in April 2017, four months after the accident, detecting a number of anomalies and procedural deviations that were not recorded during Pakistan civil aviation authority audits.

The inquiry says the oversight mechanisms of PIA and the civil aviation authority were found to be "inadequate" at identifying and monitoring performance indicators. "Furthermore, the mechanism for a proactive intervention upon such findings was ineffective," it adds.

Investigators found that, three weeks before the crash, the ATR had undergone an engine change, with the installation of a powerplant taken from a sister aircraft in the PIA fleet.

This engine had power turbine blades which had reached time limits requiring them to be changed, but this was not carried out at the time of the swap.

"Missing out of such an activity highlights a lapse on the part of [the airline's maintenance and quality-assurance] as well as a possible inadequacy [or] lack of oversight by [the civil aviation authority]," the inquiry states.

Investigators made interim safety recommendations to the authority in January last year, stating that the root cause of maintenance lapses needed to be identified and corrective measures implemented to avoid a recurrence, and that the civil aviation authority needed to evaluate and strengthen its oversight mechanisms.

Separately, a civil aviation authority probe has concluded that the licences of two of the ATR's crew were valid, after suspicions had been raised over their qualifications.

Pakistan's civil aviation authority initiated an examination of pilot licensing records in 2019, finding evidence of irregularities in the conduct of ground examinations.

Three pilots – a captain and two first officers – were in the cockpit of the PIA ATR at the time of the crash.

The inquiry says the names of the captain and the first officer seated in the jump seat appeared on the initial list of pilots whose licences were considered suspicious. However, further investigation saw them removed from this list.



Airbus touts hydrogen power in pod format

Airframer unveils configuration with multiple self-contained propulsion systems under ZEROe programme

Airbus

David Kaminski-Morrow London

Airbus is preparing a patent application for a distributed pod-based configuration for a hydrogen fuel-cell powerplant, which it is exploring as a possibility to overcome the problems of scaling up the technology for use with large transport aircraft.

While smaller propeller-driven aircraft, up to about 20 seats, can take advantage of standard twin-engined arrangements when testing hydrogen-based power, larger designs with longer range "require another solution", says the airframer.

It is looking into - among other options - a pod-based powerplant design that effectively uses self-contained propulsion systems which would be individually mounted on the wing.

Each pod acts as a standalone engine, featuring a liquid-hydrogen tank, fuel cells, electric motors and propellers, plus other electronic and cooling systems.

Airbus has unveiled a potential configuration using six of these pods, each with an eight-bladed composite propeller - one of several designs that the airframer is currently examining under its ZEROe advanced zero-emissions aircraft programme.

"These pods are not designed to be driven by any ordinary propulsion system," the company says. "Hydrogen fuel cells are among the key components."

The nature of hydrogen fuel cells requires a "unique approach", says ZEROe aircraft lead architect Matthieu Thomas, with Airbus publishing a patent application for the configuration. "The pod configuration is essentially a distributed fuel cell propulsion system that delivers thrust to the aircraft via six propulsors arranged along the wing," Thomas says.

Final decision

The distributed architecture of the pod configuration, Airbus argues, potentially simplifies such issues as fuelling and maintenance.

But vice-president of zero-emission aircraft Glenn Llewellyn points out that the design, while a "great starting point to nurture further inquiry", is not a final selection. Airbus is looking to narrow its options over the next five years and reach a decision around 2025. "This is one option, but many more will be conceptualised," says Llewellyn.

Airbus says it expects to submit "several" more patents as part of its ZEROe research. "Although advanced in its design, the pod configuration still requires a lot of work to determine whether it could be a suitable solution," it adds. ▶

EcoPulse passes PDR stage

Dominic Perry London

Daher has been cleared to begin assembling in late 2021 the hybrid-electric EcoPulse demonstrator it is developing with Airbus and Safran, after the aircraft passed its preliminary design review (PDR).

First flight of the EcoPulse is scheduled for 2022. It features six Safran-supplied 50kW electric motors on the wing, plus a conventional turboprop engine in the nose, which doubles as a turbogenerator.

Unveiled at the 2019 Paris air show, the programme is backed by France's CORAC civil aviation research council; state support was underlined in the French government's aviation rescue plan in June 2020.

Under that initiative, Paris is keen to promote projects that will enable commercial aviation to cut greenhouse gas emissions in future. EcoPulse, the partners argue, lays out "the framework for light aircraft by the end of the decade".

EcoPulse is based on a Daher TBM airframe. The conclusion of the PDR has enabled the demonstrator's baseline configuration to be frozen.

In addition, it confirmed "the hybrid distributed propulsion system's level of safety and compatibility with the aircraft".

Safran has validated the electric thruster configuration, along with installation interfaces, the power management system and high-voltage wiring. Airbus will carry out windtunnel and endurance tests on a complete thruster - the motor, propeller and nacelle - in early 2021.

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From 



Fault caused a 'graceful degradation' in performance during 30min flight

eCaravan landed with lower power

Magnix admits that electric Cessna had inverter issue on test flight which cut output of battery-powered engine to 75%

Pilar Wolfsteller Las Vegas

Electric propulsion specialist Magnix has confirmed that an electric-powered Cessna 208B Grand Caravan it was demonstrating landed under degraded power after an issue with an inverter during a 2020 test flight.

"We had an electrical issue where one of the four inverters did what it was supposed to do - it shut down, leaving the pilot [with] only 75% power," Magnix chief executive Roei Ganzarski tells FlightGlobal. "It wasn't that the battery died."

Magnix and flight-testing company AeroTec partnered to fly a Caravan equipped with Magnix's 750hp (559kW) Magni500 all-electric powerplant.

The aircraft, dubbed an "eCaravan", made its maiden flight on 28 May from Grant County International airport in Moses Lake, Washington. It flew for about 30min before landing safely, according to the company.

Ganzarski says the electric system "did exactly what it was supposed to do" during the test flight. The system lost only partial power and the programme has benefited from the lessons learned, he adds.

He was responding to a question about whether the aircraft's pilot had been forced to land without

power. That is only "partially" true, Ganzarski says.

"When they had a fault coming out of the electrical system into one of those inverters, that inverter shut down in order not to impact the rest, and did what we call a graceful degradation, leaving the pilot with partial power," he says. "So, it only shut down a quarter; if you have a fault with an engine, you'd have to shut the whole thing down."

An inverter controls the frequency of power supplied to a motor to control its rotation speed.

Economical operation

Magnix, with offices in Australia and Seattle, has been working on the Grand Caravan project alongside other electric-aircraft efforts.

It is one of two companies supplying propulsion systems for Alice, an all-electric nine-passenger aircraft being developed by sister company Eviation Aircraft.

Magnix and AeroTec say their modified Grand Caravan proves that small all-electric aircraft can feasibly and economically operate short routes that airlines had long ago abandoned.

Meanwhile, rival electric aircraft developer Ampaire has flown its hybrid-electric powered Cessna 337 Skymaster on what it calls an "actual airline route", between two of Hawaii's islands.

On 22 November, the company flew the modified aircraft, which it calls the Electric EEL, on a round trip from Kahului to Hana, both on Maui - a 20min flight of about 24nm (45km). The Electric EEL completed the round trip on a single battery charge, Ampaire says.

Ampaire says the Kahului-Hana flight makes it the first company "to complete a demonstration flight of a hybrid-electric aircraft along an actual airline route".

Ampaire is performing demonstration flights in Hawaii via a partnership with local intra-island carrier Mokulele Airlines.

Kevin Noertker, Ampaire chief executive, says the flights will demonstrate the "robustness of Ampaire's technology" and aid development of future projects.

Cessna 337s have two piston engines - one driving a forward-facing prop, the other driving a pusher prop. For the EEL, Ampaire replaced the six-seat aircraft's forward engine with an electric system "capable" of producing 160kW, it says. The 300hp rear engine remains in place.

Mokulele has signed a "letter of interest" to acquire aircraft from Ampaire, and the EEL project has support from Mokulele parent Southern Airways. ▶

Additional reporting by Jon Hemmerdinger in Tampa

Supplier selection powers up BEHA

Honeywell, Magnix, Cambridge Consultants and Nova to work on hybrid-electric effort as Faradair seeks £1 billion in funding

Dominic Perry London

UK start-up Faradair Aerospace will shortly begin a two-year engineering effort as it works to integrate a newly selected propulsion system into the first prototype of its BEHA hybrid-electric aircraft.

In addition, the Duxford airfield-based company is continuing its efforts to secure the estimated £1 billion (\$1.3 billion) required to bring the BEHA – or Bio Electric Hybrid Aircraft – into production.

On 17 December Faradair announced it had selected Honeywell to supply the BEHA's turbogenerator, avionics and flight-control systems, while Magnix is to provide Magni500 electric motors – two for each aircraft – plus control systems.

In addition, Cambridge Consultants has been recruited to provide engineering and powertrain integration services, and Nova Systems is to assist Faradair with the development of the prototype, in line with certification standards.

Speaking to FlightGlobal, Faradair founder and chief executive Neil Cloughley says the supplier selection is the culmination of three months of work since the company gained new impetus from its September move to the Duxford AvTech centre in Cambridgeshire.

"Our focus has been to secure the main partners for the programme, then we can fine-tune the aircraft around these key components," he says.

Cloughley says that negotiations are ongoing with potential fuselage suppliers, a decision on which will be aided by the forthcoming appointment of a head of engineering design authority.

Detailed structural engineering work will begin now, with assembly of the first prototype scheduled to start in 2023, ahead of a planned first flight in 2024.

Proof-of-concept

Faradair intends to deliver an "initial portfolio" of 300 BEHAs in the 2026-2030 period at a rate of 60 aircraft per year "in the largest proof-of-concept air mobility programme ever created".

It intends to equip 150 of the aircraft in a firefighting configuration, with both sensors and the capability for aerial delivery of water or suppressant; 75 examples will be in a quick-change passenger-to-cargo configuration; 50 will be dedicated freighters; and 25 will be demonstrators for governmental missions such as border and fisheries patrol, or drug interdiction.

Cloughley does not intend to sell the aircraft, however: they will be owned and operated by Faradair

for its customers in the same way that SpaceX provides its hardware and services. "We are creating an asset to support our business model," he says.

However, a small number may be dry-leased to selected operators.

He estimates that it will cost around £1 billion to get the BEHA through the development and certification phases, and to produce the first 60 aircraft. Despite the seemingly intimidating size of that figure, Cloughley insists it is "not a huge amount of money" for the aircraft finance market.

He says Faradair is attracting strong interest from that community, not least because of the current poor returns available from commercial aviation.

Cloughley, who has a finance and leasing background, argues that because the manufacturer will spread the aircraft across four sectors, it will be able to generate a steady double-digit return on investment across a 10-year period, despite any industry cyclicity.

However, Faradair has still to attract any investment from the UK government, despite its Cambridgeshire headquarters and a promise to create 1,500 highly skilled jobs at Duxford if the site is confirmed as the location for the BEHA's final assembly line.

While the initial batch of aircraft will have hybrid-electric propulsion, Cloughley says the design will allow conversion to a zero-emission architecture – batteries or fuel cells – when technology has matured sufficiently. This is likely to be in the early 2030s, he believes.

The BEHA's striking triple box wing configuration, composite construction and tail-mounted pusher propfan, plus electric motors on the wheels, are designed to enable short runway performance. This will allow the aircraft to access thousands of under-utilised facilities and create "affordable regional transport", says Cloughley. It will be able to accommodate 18 passengers or 5t of cargo, including three LD3 containers.



Faradair

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Embraer's force Meijer

Despite challenges posed by collapsing air transport market – and fallout from failed merger with Boeing – the head of Brazilian airframer's commercial arm is staying positive

Dominic Perry London

If there were an optimum time to take over as chief executive of a business it would probably be when sales were at their most buoyant, the outlook was robust and the wider industrial landscape was settled. It would certainly not be during the deepest crisis your industry has ever known and hot on the heels of a collapsed merger that promised to inject new momentum into the business.

But that scenario is precisely what Arjan Meijer faced when he became chief executive of Embraer Commercial Aviation in June. Coronavirus travel restrictions and plunging demand had forced airlines into a battle for survival, with knock-on consequences for their aircraft suppliers.

And if that was not bad enough, at that point Embraer was still working out how to piece itself back together, having carved out the commercial aviation business in anticipation of the sale of an 80% stake to Boeing. When that deal collapsed in April, the Brazilian airframer had to undo all the complex work it had performed over the previous two years – at not insignificant cost – at a point where it could ill-afford any missteps.

"It has been an interesting year," says Meijer, with a huge dollop of understatement.

Certainly the impact of the coronavirus downturn is evident from its order and delivery activity: E-Jet shipments have slowed to a trickle, down to 16 in the first nine months of 2020, from 54 a year earlier, while only 20 new orders have been recorded. In addition, two E190-E2s were added to the backlog following Congo Airways' conversion of an existing order for a pair of E175s, while Switzerland's Helvetic Airways also converted four of its remaining firm E190-E2 orders to the larger E195-E2.

If there is a positive aspect to any of this, however, it is that there have been no cancellations. Some customers have deferred deliveries into 2021 and 2022, says Meijer, but none has taken the more drastic step.

"I believe airlines are committed to these aircraft because they need them for their networks. That has not changed – the long-term need is still there," he says.

In fact, Meijer, the unit's former chief operating officer, seems strangely confident, in contrast to the depressed outlook found elsewhere in the industry. But it is a belief in both Embraer's products and the market conditions for them that appear to be buoying his mood.

Swift recovery

Meijer's contention is this: while IATA forecasts suggest that the international aviation market as a whole will not return to 2019 levels until 2024 or 2025, the sub-150-seat segment in which Embraer operates will recover much more quickly. And as operators try to cope with lower passenger numbers on short-haul routes, they will have little option but to turn to smaller aircraft that offer the efficiency promised by the latest generation of the company's E-Jet range, the E2.

"In commercial aviation we are confident going forward that airlines will look at our segment," he says. In the "new world after Covid", Embraer "can offer a very compelling product to help them

get out of the crisis." Its recent 10-year forecast suggests a requirement for 5,500 aircraft in the sub-150-seat segment by 2029.

A return of customer confidence is key, and assuming that comes back "then airlines will rebuild their networks and will re-engage in fleet discussions," he says. Carriers looking to downgauge will also be a driver of the renewed sales activity, he says.

But since their launch in 2013, customers have been slow to embrace the E2-series jets. Or rather, while there was an initial flurry of orders, cancellations have steadily eaten into the total: Embraer has taken firm orders for 173 aircraft, while the undelivered backlog is 151.

Although the majority of cancellations were from one carrier for the smallest family member – SkyWest Airlines axed an order for 100 E175-E2s due to issues related to scope-clause relief in the US regional market – Embraer has struggled to bring in what former commercial aviation chief John Slattery used to refer to as a "marquee customer".

While Azul and KLM have signed up, the remainder of the airframer's backlog for the E2 family comprises either lessors or smaller, regional carriers.

Meijer thinks that several factors have hampered sales over the preceding years. Firstly, the relative youth of the 1,500-strong first-generation E-Jet fleet has been a

"I believe airlines are committed to the E2 aircraft because they need them. That has not changed – the long-term need is still there"

Arjan Meijer Chief executive, Embraer Commercial Aviation



Meijer took division's top job in June

Embraer

brake on new orders. "The E2 came to the market rather soon in the life of the E-Jets – the E1 is still young," he says. But with that fleet now beginning to age, many of the "marquee" airlines that fly the older variant will be looking "to replace them with a more efficient successor".

In addition, the "uncertainty" around the merger with Boeing created another headwind, says Meijer. Announced in December 2017, negotiations over the deal dragged on for over two years before it fell apart. Although he says it is impossible to quantify the impact, he notes that "as with any market, uncertainty is never your friend. The fact that it was not clear that the deal would happen just did not help us."

But the chief rationale for the tie-up with Boeing in the first place

was as a response to the acquisition by Airbus of the CSeries – now the A220 – from Bombardier. Since gaining the sales and marketing heft of Toulouse, the A220, which competes with the E2 range, has secured several big orders, including from JetBlue Airways and Air France.

Market dynamic

That market dynamic does not appear to have vanished, but Meijer seems sanguine about Embraer's ability to stand on its own feet. Although he acknowledges that he was "surprised and disappointed" when Boeing pulled the plug, he thinks that the coronavirus-re-shaped market means some of the logic that drove that deal no longer applies.

Besides, he maintains, the E2 can still out-compete the A220. And on

top of which, Embraer hopes to "reduce the cost of the product significantly" as it leverages savings from a company-wide efficiency drive.

Although Embraer may no longer need a partner on the scale of Boeing, where it does need an ally is for the proposed development of a new turboprop airliner. The Brazilian airframer has been clear about this all along – in January 2020 the company's message was broadly "no [Boeing] JV, no TP" – Meijer reveals that Embraer is now in "active talks" with interested parties.

173

Firm orders for E2-series jets; the undelivered backlog stands at 151

"We still believe in the turboprop, we have a good proposition in mind. But we are very clear that we are looking for a partner to bring that to life," he says.

Meijer declines to reveal details on the discussions, but says the potential collaborators are from both the financial and industrial sectors.

As the aircraft remains at the concept study stage and is yet to be officially launched, there are few firm details. But what Embraer has said so far is that it will sit in the 70-100-seat segment – slightly larger than the ATR 72-600 – and have conventional rather than hybrid-electric engines. It is also likely to use the same fuselage as the current E-Jets, in order to benefit from industrial synergies.

The decision to opt for conventional propulsion was a simple one, he says. "The market is not ready yet, technically or economically, to put another technology on a turboprop." To add a hybrid-electric powertrain – even one delivering as little as 5-10% of the total requirement – would increase operating costs by 15%. Or, as Meijer puts it: "It would add a lot of cost for limited benefit."

Embraer's strategy, he says, is to bring to market a turboprop that delivers the step-change in sustainability and operating economics that the original E-Jets offered over the previous generation of regional jets.

"They were the most sustainable and economical aircraft: that is what we will do going forward." ▶



On the attack

Embraer defence chief sees more sales ahead for KC-390

Greg Waldron Singapore

While not as deeply affected as its commercial aviation sibling by the collapse of a deal with Boeing, Embraer Defense & Security was still anticipating a boost from a new relationship with the US airframer.

That uplift was to come from the creation of a joint venture to sell Embraer's KC-390 Millennium tanker/transport - the division's biggest and newest product.

However, the Boeing deal collapsed in April.

Despite this, and the raging coronavirus pandemic, divisional chief executive Jackson Schneider remains full of confidence.

In part, that is due to momentum for the KC-390: in November, Hungary announced that it would acquire a pair of the twinjets to replace its retired Antonov An-26s.

This latest commitment takes to 35 total firm orders for the type: 28 for Brazil (three have been delivered); two for Hungary; and five for Portugal. A further 33 aircraft are covered by letters of intent from Argentina, Chile, Colombia, the Czech Republic and aviation services firm SkyTech.

Schneider believes Embraer can win additional customers - even without a sales partner.

"Boeing may perhaps have added some possibilities in terms of sales, but I think that we can manage it alone," he says. In 2021 Embraer

hopes to sign another international order for the type, he adds.

"I'm pretty sure that the plane will be successful, and with or without Boeing we can manage it very well. The plane will be flying in all continents, it's a question of time."

Of course, the time required to get deals across the line increased in 2020 due to the restrictions imposed by Covid-19.

Schneider says that sales campaigns have been particularly hit by the coronavirus, many of which have been suspended as governments grapple with the pandemic.

"We didn't lose any campaigns," says Schneider. "We just suspended some of them and delayed others. But we are now retaking them. We believe that we will have the same momentum that we had before the outbreak."

Challenging times

But the process of getting aircraft to their customers has also been rendered more challenging.

Take the recent shipment of six A-29 Super Tucanos to the Philippines. It is a long journey at the best of times for a turboprop from Embraer's Jacksonville, Florida factory to Manila, but the coronavirus pandemic lent the delivery flight an epic quality, with stops in the Canary Islands, Portugal, Malta, Egypt, the United Arab Emirates, India, Bangladesh, Thailand and Vietnam.

"It was a really big effort, because you have to cross the world with a lot of [coronavirus] affected countries," he says. "Some were closed,

required special authorisations, special licences. But it was a great team effort... sure, it cost more in terms of energy and in terms of resources, but we were there."

Meanwhile, Embraer is gearing up to produce the Saab Gripen E at its Gaviao Peixoto factory. Brasilia has ordered 36 E/F-model fighters, locally designated the F-39, which involves substantial technology transfer to Brazil.

Saab is currently marketing the Gripen E to Colombia, which is looking to replace its Cessna A-37s and Israel Aerospace Industries-built Kfirs. But should Bogota select the Swedish jet, they are more than likely to be built at Gaviao Peixoto rather than Linkoping.

"We'll be more than happy to help Saab to assemble planes not only for Colombia, but for other countries as well," says Schneider.

Just as Brazil partnered with other nations for the development of the KC-390, so Embraer is open to collaboration on its latest project.

Called the STOUT - Short Take Off Utility Transport - the hybrid-electric aircraft is being developed for the Brazilian air force.

Schneider believes STOUT offers an opportunity for countries interested in developing their own aerospace industries. Embraer has already received enquiries about participation in the project, he says.

"This is very good for countries who want to master the aeronautical engineering process, because you'll be developing a plane from scratch," he says. ▶

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Ace flying high after first deal

French aerospace investment fund backed by private sector, government and industry targets its next acquisitions

Dominic Perry London

Ace Aero Partenaires, the public-private investment fund backed by the top four companies in the French aerospace industry, hopes to conclude its next set of deals in the coming months, with the aim of hitting “cruise speed” by mid-2021.

To date, the fund has €630 million (\$744 million) under management, and has invested in one business since its July launch, in October acquiring Nantes-based Aries Alliance.

But “two or three cases are being investigated deeply” says Marwan Lahoud, executive chairman of Ace Management, the private equity firm that manages the fund.

“We are ready to take on another situation like Aries, or other deals.”

Lahoud, a former top Airbus executive, says the investment in Aries, which could eventually reach €20 million, was needed due to the company’s parlous financial state.

“It is a very interesting and technology-rich company that was suffering from a very poor balance sheet,” he says.

Ace will assist with the restructuring of Aries’ debts, which should be completed around mid-December, and then help to

“revisit the strategy” to ensure it is fully adapted to the new aerospace business environment.

While Covid-19 likely hastened Aries’ need for a financial bailout, its issues pre-date the pandemic, says Lahoud.

Aries, which specialises in making machines for aerospace production, and the manufacture of complex metallic components, “had been very successful not that long ago”, but “two or three bad decisions” had hobbled it, he says.

He sees a three- or four-year effort required to fully transform the company, although he stresses that Ace may not divest the business once the turnaround is achieved, diverging from the traditional private equity model of seeking an exit and financial return after three years.

Ace Aero was established on the back of the French government’s Plan Aero strategy, revealed in June, to support the country’s aerospace industry through the pandemic-induced crisis; Ace Management was chosen to run the fund after an open competition.

Initial investment has come from Tikehau Capital, Ace Management’s parent company, plus France’s big four aerospace primes – Airbus, Dassault, Safran and Thales – and the French government via its BPI France investment bank.

The Ace Aero fund is actively seeking additional capital from the private sector to meet a target of reaching €1 billion under management by some point next year.

Ace Aero has two streams of support for industry: direct financial investment, as in the case of Aries, where a company needs rescuing; and funding to assist consolidation in the supply chain.

While the former is available only to French businesses, the second is open to any aerospace company in Western Europe, says Lahoud; two applications have already been received from outside of the country for this “platform” investment.

Value chain

Businesses seeking funding are assessed based on “their importance to the value chain”, he says: “How key is the company in its technology or the criticality of its deliveries.”

While Ace Management may not be a household name, this is not the first aerospace-related fund it has established: three previous efforts saw sums of €50 million, €100 million and €200 million managed, with investments including Meccachrome and Nexteam Group.

Although the big four aerospace firms are likely to see a financial return on their investments, that is not their main motivation, says Lahoud.

“Their main focus is safeguarding the key players for them, either through support or gaining the benefits of consolidation.”

UK aerospace trade body ADS had hoped that the British government would create a similar scheme – which it refers to as a “patient capital investment fund”. However, there was no mention of any dedicated support for the aerospace sector in the autumn spending review announced by Chancellor Rishi Sunak on 25 November.

ADS says it continues to discuss with the government about what “additional support they can offer to supply chain companies who need it”. However, it notes that it is “too early to say exactly which direction these discussions will go”. ▶



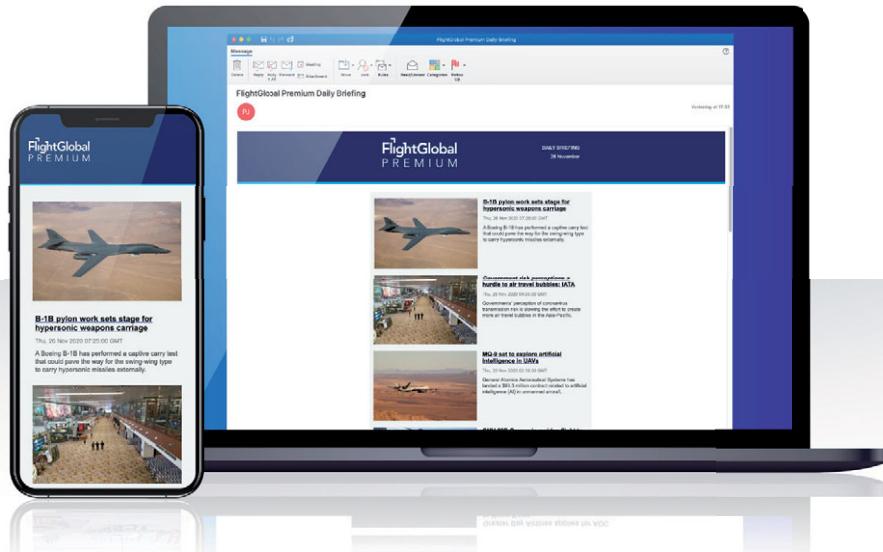
Safran has contributed to €630 million fund

Adrien Daste/Safran



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Bell

Manufacturer has used modified 429 medium-twin to trial technology

Bell advances electric tail rotor

Airframer confident that it can bring design into production as it analyses data from successful demonstration phase

Dominic Perry London

Bell is confident that its EDAT electric tail rotor system will eventually make its way into production, although the manufacturer cautions that this may not happen for another five to 10 years.

Testing of EDAT (or electrically distributed anti-torque) – which replaces the traditional mechanical tail rotor with four electric-powered fans – has been taking place at Bell's Mirabel, Canada facility since May 2019 using a modified 429 helicopter.

On 14 December, the airframer showcased the system at Aero-Montreal's 2020 Innovation Forum. Speaking at the event, Steeve Lavoie, president of Bell Textron Canada, said it was a "medium- to long-term goal" to bring EDAT into commercial service.

Although declining to offer a more specific timeframe, Lavoie says the system "will be put on to a programme at a certain point".

Bell continues to analyse the results from the EDAT demonstration phase, and will then work to optimise the system in order to bring it to the required technology readiness level, he says.

"It is more realistic to look at five to 10 years before we can see such a product commercially produced on many aircraft," Lavoie says. "We have a lot to do."

The EDAT system comprises four distributed fixed-pitch fans driven by separate electric motors, embedded in an enlarged vertical fin, in place of the traditional tail rotor.

Power comes from generators running off the tail rotor drive. Cables replace the usual driveshaft and gearbox assembly, reducing complexity. The fans run at around 6,000-7,000rpm but can be individually slowed or reversed depending on requirements.

Improved safety

Bell cites improved safety, lower noise levels and reduced operational and maintenance costs as key advantages for the system. It has accumulated around 25h of ground and flight testing to date.

Although it will not offer specifics, Bell says in tests the EDAT system produced lower noise levels than a conventional tail rotor. Using optimised components – rather than off-the-shelf parts as on the demonstrator – would reduce this further, it says.

A number of flight phases have been evaluated, including take-

offs, sideways flight and cruise, says Thuva Senthilnathan, programme manager, commercial development programmes at Bell.

But an in-flight failure of one or more fans has yet to be tested, he says. "Given that this is a demonstrator aircraft we didn't want to try a failure in the air. But we did evaluate the thrust [produced] on the ground and if we did lose one fan we would still be able to hover safely and get back onto the ground."

While the medium-twin 429 was selected for the demonstration effort, Senthilnathan says that the technology would be suitable for any size of helicopter. However, he notes that "a bigger aircraft is more forgiving" in terms of the addition of extra components.

As part of the optimisation process, Bell is looking at how to balance the cost and weight of EDAT. "One challenge is to package the system in such a way that it is palatable to the market," he says.

Recent patent awards in the USA show that Bell is keen to advance beyond the basic EDAT concept. Senthilnathan says the company will in future evaluate other configurations, either on the ground or in flight. In a filing that was approved on 29 September, the manufacturer outlines an anti-torque

system that could pivot to provide directional thrust depending on the flight mode.

Drawings submitted with the filing show an array of six "fixed blade pitch motors" arranged in a circle, with a seventh motor in the centre; these are depicted as both shrouded and unshrouded configurations.

However, the patent's text makes clear that Bell sees the potential for an anti-torque assembly with "15 or more fixed blade pitch motors" depending on the application.

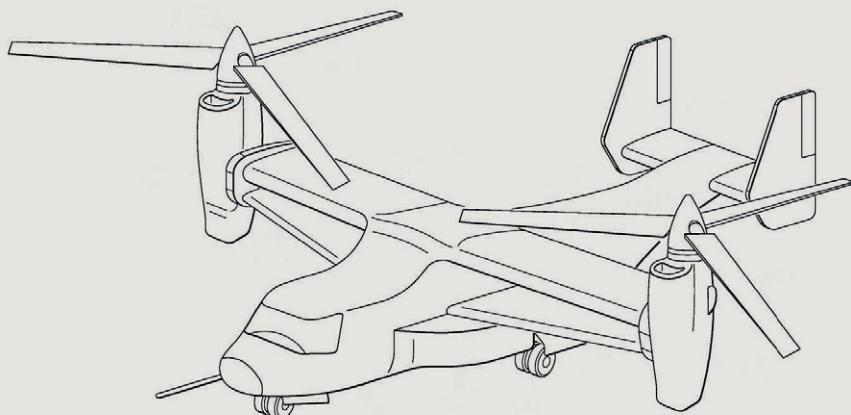
Variable thrust

Individual electric-powered motors, or the entire assembly, may be surrounded by a cowl, and all or some could be pivoted to vary the direction of thrust. Bell says the assembly would be in line with the tail boom during hover and "substantially perpendicular" during forward flight.

Thrust directed towards the rear of the helicopter would add "to the forward thrust, which is generally used in high airspeed cruise", the patent says, and would "increase cruise efficiency".

The system's deployment, and the direction and speed of the fans would be regulated by a flight-control computer "to position the anti-torque assembly system for optimum thrust angle... and magnitude".

Bell states that the variable direction assembly could enable the elimination of vertical and horizontal stabilisers from helicopter designs, saving weight and reducing complexity. For example, it would remove down-loading – where the wash from the main rotor exerts a downward force on the horizontal stabiliser. ▶



A second take for tiltrotor technology

While many of Bell's newest patents are for individual components or structures, perhaps the most striking of the recent designs is for a biplane tiltrotor.

Images submitted as part of the patent application show several variants of the biplane design – with the wings variously parallel, or in anhedral or dihedral orientations. Also shown is a four-rotor design with two pairs of wings.

Bell argues in the patent – granted on 17 November – that the biplane configuration eliminates some of the "drawbacks" of a conventional, monoplane tiltrotor.

Because both the upper and lower wings provide lift, they can be smaller than that of a monoplane design – for example, the chord of the upper wing can be reduced by "roughly 50%". This cuts the magnitude of the downward force caused by the rotor downwash on the upper wing in helicopter mode, boosting the lift from those rotors.

This improved efficiency allows for "a larger payload,

longer missions [or] reduced fuel consumption", it states.

Wing "down-loading" could be cut further with the use of a forward lift-generating canard, allowing the chord of the upper wing to be made even smaller.

The biplane design would also provide "additional structural support" for tiltrotor components sited at the end of the wings, such as nacelles and pylons. Because the complete design is stiffer, overall weight could be reduced, says the filing.

In a sign that Bell has military applications for the technology firmly in mind, one illustration shows weapons mounted on the lower wing. "In this manner, weapon ordnance is mounted in a location that is unobstructed by the blades of the tiltrotors", the application states.

Bell is a major advocate of tiltrotor technology. It currently produces the V-22 Osprey in collaboration with Boeing, and has submitted the next-generation V-280 Valor for the US Army's Future Long-Range Assault Aircraft requirement.

Bell/US Patent and Trademark Office



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A decade in the shadows

Beijing has kept a veil of secrecy over its J-20 stealth fighter programme since 2011 – and we should not expect that to change soon



AirTeamimages

PLAAF is keen to emphasise type's manoeuvrability

Greg Waldron Singapore

Ten years after its maiden flight, the Chengdu J-20 remains the world's most enigmatic fighter.

On 11 January 2011, then-US defence secretary Robert Gates sat down with Chinese premier Hu Jintao in Beijing to discuss ways to improve defence ties. Just hours before, images of the maiden flight had flooded China's internet.

"This is about as big a 'f*** you' as you can get," an aide told Gates, according to his memoir.

Gates's team considered calling the high-level meeting off altogether. Instead, he asked Hu directly about the test. The Chinese civilians in the room seemed shocked by the query, apparently unaware of the milestone.

After several minutes of discussion between the Chinese delegation, Hu finally told Gates that the roll-out had been a "previously scheduled scientific test". Gates believes the People's Liberation Army (PLA) would have given him a different explanation.

In this dramatic fashion, the J-20 entered the fighter world's central stage. Aviation experts and

amateurs alike pore over every photograph that emerges of the iconic, twin-tailed type, noting fuselage numbers, design tweaks, and most importantly the J-20's all-important engines. By comparison, the successes and failures of the Lockheed Martin F-35 are an open book.

In those early days of the J-20, what intelligence there was had to be derived from aviation enthusiasts near the Chengdu airfield where the type is produced. Video and photographs of matt black J-20s were frequently posted on China's internet.

Public appearances

Over the years, however, the steady stream of imagery and video from Chengdu has fallen off. This potentially relates to a tighter security environment in China in the era of President Xi Jinping. Still, there are plenty of sightings from air bases around China and in satellite images, and the J-20 has also made some public appearances.

In November 2016, a pair of People's Liberation Army Air Force (PLAAF) J-20s conducted a brief flypast at the opening ceremony of Airshow China in Zhuhai. Their appearance was a major sensation, but in the vast AVIC display inside

the show, there was not an image or model of the J-20 to be found.

Two years later, four J-20s participated in the flying display, but there was a lack of aggressive manoeuvres, such as those which are routine for the fighter to which the J-20 is most often compared: the US Air Force's Lockheed F-22.

The 2018 Zhuhai show saw another first, with AVIC distributing a flyer with this brief description: "The J-20 developed independently by China is a heavy stealth fourth-generation fighter (aka fifth-generation internationally), renowned for its dominant role of medium- and long-range air combat and excellent capability in ground and marine precision strike."

Rod Lee, research director at the China Aerospace Studies Institute (CASI), believes there are three primary mission sets for the J-20.

The first is destroying high-value airborne assets. "The combination of a large combat radius with long-range air-to-air missiles and low visibility should enable J-20s to prosecute [airborne early warning and control/intelligence, surveillance and reconnaissance (ISR)] aircraft, as well as tankers," he says.

"Conceptually, the PLAAF talks about rolling back these high-value

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targets as being a major part of establishing air superiority. This is backed by semi-authoritative sources in AVIC, who suggest that J-20 is a platform that can 'pierce the net' for other aircraft."

Supplemental mission sets include launching anti-radiation missiles and air-to-ground munitions. The PLAAF believes stealthy aircraft are essential for prosecuting key nodes, owing to the element of surprise. The last role Lee suggests is destroying other fighters in air-to-air engagements.

"The PLAAF does indeed like to tout the J-20's manoeuvrability and air-to-air combat performance," he says. "Given this, the PLAAF almost certainly will use the J-20 as an air superiority fighter against other fighters. But the PLA de-emphasises the importance of attrition warfare and instead advocates a 'systems destruction' approach. Killing individual adversary fighters (even in large numbers) is not as useful as killing [high-value airborne assets] and key ground targets."

Estimated numbers

Andreas Rupprecht, an avid observer of Chinese military aviation and author of *Modern Chinese Warplanes*, says some estimates of J-20 strength put the overall number at 40-60 airframes, but says only 20 examples have been confirmed.

Rupprecht believes prototypes should be designated J-20s, and low-rate initial production examples powered by Russian Saturn AL-31FN engines as J-20As. Aircraft using indigenous WS-10C Taihang engines would be J-20Bs, and those with advanced WS-15 Emei powerplants C-models.

Based on images of recent J-20s, Rupprecht believes that since mid-2019 all factory-fresh examples use WS-10C engines, with distinctive sawtooth exhaust feathers, and that a WS-15-powered aircraft is in testing. The latter standard will take until 2025 to reach operational service, he estimates.

While the use of WS-10Cs is a major breakthrough, in that it erodes Chinese dependence on Russian engines, estimates suggest that the WS-15 will have a maximum thrust rating of 40,500lb (180kN), potentially enabling 'supercruise' performance: the ability to sustain supersonic speed without maintaining the use of afterburners.



Chinese social media

Large canards appear at odds with stealth claims

Even less is known about the J-20's other key technologies. It is taken for granted that the type has an active electronically scanned array radar, but the capabilities of its distributed aperture system (DAS) are a matter of speculation.

The F-35's ability to fuse data from its radar, DAS and other systems offers excellent situational awareness, and can inform external platforms through datalinks. But this advanced technology proved troublesome even for the USA.

On the matter of stealth, Royal United Services Institute analyst Justin Bronk classifies the J-20 as a low-observable (LO) aircraft, while classifying the F-22 and F-35 as very-low-observable (VLO).

20

Confirmed examples of J-20, but total strength estimated at 40-60 airframes

"The J-20A features forward canards, which are not ideal from a VLO perspective, and initial batches have been powered by AL-31-series engines without LO serrated nozzles," Bronk wrote in a recent report.

"These engines not only leave the design somewhat underpowered and likely unable to supercruise, but also increase the [radar cross-section] when the aircraft is viewed from the rear, overhead or underneath."

The J-20's degree of stealth, however, is suitable for an aircraft operating near Chinese airspace with a great deal of background clutter, such as non-LO aircraft and

considerable "noise" across the electromagnetic spectrum.

"The threat of J-20s with long-range PL-15 missiles operating within the background chaos would be a major headache for US planners attempting to protect critical tanker and ISR orbits within useful range of the area of operations," he writes.

Airborne threat

Two small weapons bays - one mounted on the side of each engine intake - can accommodate PL-10 short-range air-to-air missiles, while a pair of larger bays beneath the fuselage have been photographed carrying two long-range air-to-air missiles each. The J-20 also has four external hardpoints that can carry ordnance or external fuel tanks.

Asked about possible weaknesses, CASI's Lee identifies two. Since Chinese aviation brigades provide organic support to their aircraft, any J-20s deploying to a remote base will need to travel with their own support elements.

"Given that other PLAAF fighters like the [Chengdu] J-10 and [Shenyang] J-11 are far more prolific, they could probably get away with forward deploying a detachment to another airfield with J-10s and not bringing maintenance personnel. The J-20s don't have that luxury."

Lee notes that the PLA has acknowledged that its older officers are not capable of dealing with modern warfare, so planners may not be able to fully appreciate the J-20's advanced capabilities.

The J-20 should come of age during its second decade, remaining a powerful symbol of China's military ambitions. But while it is Beijing's most talked about fighter, it will also continue to be subject to its obsession with secrecy. ▶



Naval Group

France launches future carrier study

Replacement for *Charles de Gaulle* flagship due in 2038, with New Generation Fighter on board to deliver offensive power

Craig Hoyle London

Paris has begun the process of designing a replacement for its nuclear-powered aircraft carrier *Charles de Gaulle*, with industrial lead Naval Group saying its successor will be “the biggest warship France has ever built”.

French President Emmanuel Macron on 8 December launched the Porte-Avions Nouvelle Génération project, which will deliver an operational replacement for the navy’s current flagship in 2038.

France’s defence ministry says the new vessel should have a displacement of around 75,000t and be about 300m (984ft) long. It will deploy an air wing including up to 30 examples of a New Generation Fighter (NGF) being developed by France, Germany and Spain.

A two-year preliminary design study will be followed by detailed design studies running until late 2025, ahead of a contract for full development and construction.

“This project will help develop jobs in the defence industrial and technological base and ensure the continuity of our skills in the current health and economic crisis,” says Naval Group chief executive Pierre Eric Pommellet. Its major industrial partners are Chantiers de l’Atlantique, Dassault Aviation and TechnicAtome.

To meet the entry into service objective, Paris expects the new ship to commence trials in 2036. It will be powered by two nuclear

reactors – Naval Group says this will ensure “considerable autonomy at sea and a great flexibility of use” – and also feature new-generation launch and recovery equipment including electromagnetic catapults.

The defence ministry says it is too early to decide whether the navy should acquire one or two replacement ships, but notes: “two aircraft carriers guarantee to always have one on alert”.

France’s current lone aircraft carrier entered operational use in 2001. The navy embarks Dassault Rafale fighters and Northrop Grumman E-2C Hawkeye airborne early warning and control system aircraft, along with support helicopters.

Combat options

Concept images of a future carrier released by Naval Group show the vessel carrying either a full load of NGF combat aircraft, or a mix of the type alongside Rafales, along with Hawkeyes and NH Industries NH90 helicopters.

The subject of a tri-national development effort as part of their Future Combat Air System (FCAS) programme, the stealthy NGF – also called SCAF by France – is expected to be larger than the Rafale.

“The fighter and the systems we develop will have to be compatible with navy applications, including to land on an aircraft carrier,” Bruno Fichefeux, head of FCAS for Airbus Defence & Space, said on 9 December. “Finding the right trade-off will be our challenge, and we are strongly dedicated there,

with Dassault Aviation being the prime partner.

“A navy application has an impact on [aircraft] structure and [landing approach] speed, but maybe it can also help increase the performance by making the fighter able to fly slow and fast,” he notes.

Fichefeux says Airbus and Dassault in September submitted information on “the five best architectures” for FCAS, with these validated by the three nations’ air force chiefs. The proposals include large and small fighters, remote carrier vehicles and loyal wing-man-type unmanned platforms.

Meanwhile, Spain’s aerospace industry has been formally included within the FCAS initiative’s Joint Concept Study activity and Phase 1A work package, following a 10-month “onboarding” process.

Airbus Spain will head NGF activities for Madrid, and be prime contractor on low observable technology, working in partnership with Airbus Germany and Dassault. Indra is to lead the project’s sensor-related activities.

Fichefeux says €300 million (\$363 million) has been invested in the FCAS project since early 2019, and that negotiations are ongoing with the nations and industrial partners to determine their contribution beyond the end of 2021.

“Next year we will go from a few millions to billions,” he says. “We need to reach this point of commitment to give perspective to the industry, and to reach the irreversible path for the development of FCAS.” ▶

USAF trials breakthrough network

GatewayONE technology successfully links stealth fighter communications, with unmanned Valkyrie also in formation

Garrett Reim Los Angeles

A Lockheed Martin F-22, F-35A and Kratos Defense XQ-58A Valkyrie “loyal wingman” flew in formation for the first time on 9 December, above the US Army’s Yuma Proving Ground in Arizona.

The formation flight was part of an attempted demonstration of data transmission between the trio of aircraft. The F-22 and F-35A successfully shared information via the on-trial “gatewayONE” technology, but the unmanned platform was unable to link up, the US Air Force (USAF) says.

The USAF’s two fifth-generation fighters have secure communication systems that cannot “talk” directly to one another – the Raptor has an Intra-Flight Data Link, while the Lightning II employs a Multi-functional Advanced Data Link – forcing complex workarounds during operations.

“Not only can gatewayONE translate between those formats, in this test it moved data that is normally relegated to an operations centre or tactical ground node, directly pushing it into the cockpit at the edge of the multi-domain battlespace for the first time,” says the USAF.

“Additionally, the test pushed the position data of each platform outside of the aircraft’s close-proximity formation through gatewayONE, which enables battle managers on the ground or in the air to better orchestrate operations.”

The communications device also “passed tracks or cues from ground operators to both fighters, and passed a cue from the F-35A to the F-22 for the first time,” says the service. The relayed information was presented on the fighter’s normal displays.

GatewayONE is part of the USAF’s Advanced Battlefield Management System (ABMS) development programme – an effort to create a military internet-of-things network that will quickly and



US Air Force

Raptor and Lightning II joined forces with ‘loyal wingman’

autonomously pass information around the battlefield.

“The future is promising, and gatewayONE will allow the F-22 and F-35 to connect to and feed data sources they have never before accessed,” says Lieutenant Colonel Eric Wright, a 59th Test and Evaluation Squadron F-35 pilot. “Those future connections will bring additional battlefield awareness into the cockpit and enable integrated fires across US forces.”

As part of the demonstration, the XQ-58A was rocket-launched, and made a “semi-autonomous” flight alongside the manned fighters for the first time.

Lost connectivity

“The gatewayONE payload was integrated into the Valkyrie for its maiden voyage with the fifth-generation fighters to conduct an initial test of gateway capabilities from an attritable platform,” says the USAF. “However, shortly after take-off, the communications payloads lost connectivity and those test objectives were unable to be accomplished.”

The demonstration flight programme had 18 test objectives, with nine successfully completed, the service says.

Additionally, a US Marine Corps F-35B sent full-motion video to a ground controller using the

Tactical Targeting Network Technology waveform and a USAF Boeing KC-46A Pegasus tanker serving as a communications node.

The service’s tanker fleet will be an important early part of the ABMS network, Will Roper, assistant secretary of the air force for acquisition, technology and logistics, told an Air Force Association event on 14 December.

“We have already selected ABMS release one, which is a subset of capabilities that make a mini-internet, that gets data from cloud [computing and storage] forward to the tactical edge to our fighters, via mobility gateways and analytics that will be fielded on our tanker fleet,” he says.

The USAF’s aim is to mimic many of the functions of the modern civilian internet, using artificial intelligence and other forms of automation to make fast suggestions to decision makers on the battlefield.

“It’s a microcosm of the internet, where the cloud is there, the analytics are there, the tanker is playing the role of a cell tower,” Roper says. “It’s routing data back and forth between the cloud and users. The users are the fighters that are inside that area denial, communication denial bubble, that are not denied talking with the tanker that is standing just outside of harm’s way.”

Lilium puts down roots for growth

German electric air taxi developer signs pair of critical deals covering pilot training and location for first US ‘vertiport’ hub

Dominic Perry London

Lilium has selected Lufthansa's training arm to develop a programme that will deliver a pipeline of qualified pilots for its developmental electric air taxi, as the Bavarian start-up solves another part of its pre-launch puzzle.

The news of the training tie-up in early December came just weeks after the announcement that Orlando in Florida was to be the company's launch location in the USA, after it struck a deal with the city authorities and Florida real estate specialist Tavistock Development.

Both deals illustrate important progress for the programme as Lilium slowly assembles the foundations that will support the roll-out of operations from 2025.

Under the new contract, Lufthansa Aviation Training (LAT) will initially develop a bespoke type rating course for qualified commercial pilots.

Lilium needs to ensure that there are crews available to support the start of commercial services in about four years' time and, crucially, the rapid ramp-up of services that it hopes will follow, says Remo Gerber, chief operating officer.

Gerber says the partners will take advantage of new technologies, such as mixed- and virtual reality simulation, to “push the boundaries” and optimise the training syllabus.

With its tilting banks of electric-powered fans, and vertical take-off and landing capability, the Lilium Jet has a unique design, compared with existing fixed- or rotary-wing aircraft, and therefore requires a tailored training regime, he adds.

Gerber declines to reveal the planned annual pilot throughput. Although the launch of operations could be achieved with a relatively modest number of pilots, Lilium's intention to “start scaling up [services] quite quickly”, means the requirement is “quite intense”.



Lilium

However, Gerber is confident that the training can be made “affordable”, allowing would-be aviators a path into the industry.

Gerber says that Lilium is contemplating potential funding solutions to assist with training costs.

The training programme will be defined over the next 24 months, says Gerber. “The work really starts now. In a sense, this is the beginning of the academy.”

A first batch of recruits will be required over the next three years.

A location has yet to be selected for the academy; LAT has eight sites in Germany, two in Switzerland and one in Austria, plus an additional facility in Phoenix, Arizona.

Certification plans

The partners will also work together with the European and US regulatory authorities on certification of the training programme.

Lilium has yet to conduct a manned flight of its aircraft, with that milestone to come only when it flies the first certification article in 2021 or 2022.

Meanwhile, Lilium's initial US base is to be located in Orlando's Lake Nona suburb – immediately adjacent to the city's international airport – where the first “vertiport” hub will be built by Tavistock.

As yet, no other locations have been signed up for vertiport construction, but Gerber confirms that negotiations are under way to

develop a network of destinations across the Sunshine State.

While he declines to name the other points, Gerber says the targets are “key neighbouring towns”. Given the Lilium Jet's 162nm (300km) range, that includes Tampa on the Gulf Coast, Jacksonville in the north of the state, or Fort Myers to the southwest.

However, Gerber admits that, at present, Miami and state capital Tallahassee will not be reachable by the first-generation of the five-seat jet in a single journey.

While Orlando will be the first location in the USA, Lilium in September signed a deal with Cologne/Bonn and Dusseldorf airports to create the necessary infrastructure at the sites to support regional air services with its aircraft.

Development of the Lilium Jet is continuing at the company's site in Oberpfaffenhofen near Munich, although coronavirus restrictions curtailed plans to fly its second demonstrator aircraft in 2020.

The initial example was destroyed in a February battery fire shortly before the pandemic took hold. Its successor was due to take to the skies at some point in 2020, but Gerber says this is now “anticipated” in the first quarter of 2021.

However, he stresses that the demonstrator is “not really our main focus right now”, with that instead switching to the initial certification aircraft. ▶

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Bern closes in on fighter selection

Alpine nation's search for next generation fleet is on target for conclusion by middle of 2021, after receiving final offers

Craig Hoyle London

Switzerland's protracted search for a new fighter is finally nearing an end, with Bern on course to select from its current four candidates during the second quarter of 2021.

The nation's Armasuisse procurement agency on 18 November received responses to its final Air2030 request for proposals, which sought information on the supply of 36 or 40 combat aircraft, and ground-based air-defence system equipment.

Pegged at €6 billion (\$7.1 billion), the new fighter aircraft acquisition will from 2030 replace a fleet of Boeing F/A-18C/D Hornets and obsolete Northrop F-5 interceptors. The F/A-18E/F Super Hornet, Dassault Rafale, Eurofighter and Lockheed Martin F-35A are contenders for the deal, having undergone evaluations at Payerne air base between April and June 2019.

Submissions were made three months later than originally scheduled, giving bidders more time to prepare amid the coronavirus pandemic's disruption.

"With that, Armasuisse starts to work on the evaluation reports, which are planned to be completed in the first quarter of 2021," the nation's federal department for defence, civil protection and sport says. This will be followed by a type selection by mid-year.

"By the end of 2021, we will prepare the armament bill 2022 in terms of content," says Peter Winter, Armasuisse's director of aeronautical systems and programme director Air2030. "This means that the negotiations need to be concluded by then and the contracts prepared."

Bern also requires offset business valued at 60% of the total programme cost.

"By providing construction data and other important information, Switzerland will be given complete and independent control of the Eurofighter," says Dirk Hoke,



Armasuisse

The USA has offered Switzerland up to 40 F-35As, including four built in Emmen

chief executive of Airbus Defence & Space, which is leading the Eurofighter campaign.

The German government is supporting its offer, proposing "closer political, economic and security co-operation", and expanded training between the nations' air forces.

Dassault has not disclosed details of its offer, while the US government submitted Foreign Military Sales programme proposals for both the Super Hornet and F-35A.

Optional extras

Mike Kelley, Lockheed's managing director in Switzerland, says its proposal includes 36 F-35As with associated training and sustainment services, plus "discrete pricing" for an optional four additional examples, to be built in the country.

Should Switzerland select the stealthy type and take up the local assembly offer, work would be conducted at RUAG's facilities in Emmen using Swiss personnel, and also cover test activities.

"Switzerland has some very unique requirements for autonomy and sovereignty in operations," says Kelley. The experience gained from in-country assembly would boost its ability to perform MRO tasks over an expected 30-year-plus operational life, he adds.

Switzerland would join Lockheed's F-35 global sustainment programme, and, at the request of Armasuisse, also supply a

deployed spares package sufficient to support six months of normal operations.

Kelley says the offer contains a "limited" weapons package. "That package is a little bit smaller than many people would expect, but that's because the existing inventory of munitions that the Swiss air force has for the Hornet fleet are by and large fully operational with the F-35," he notes.

Lockheed has identified companies to place work with in "all three language regions" of the country, including directly on the Swiss aircraft. It is proposing to make Switzerland a "European centre" for F-35 transparencies and canopies, and to establish a national cyber centre, "with a testbed for network environments".

"We believe that when fully evaluated by Armasuisse, it will be concluded that the entire 40-aircraft programme and all the other aspects will fit within the approved Swiss budget," Kelley says. F-35A deliveries would run from 2027 to 2030.

The current process marks the nation's second attempt to acquire new fighters. In May 2014, a proposed purchase of 22 Gripen Es as F-5 replacements was rejected during a public referendum.

In September 2020, the Swiss government won the support of 50.1% of voters to advance its latest procurement. ▶



Analysis highlights raised collision risk

Research from Eurocontrol suggests a high percentage of airline crews do not follow automated advisories properly

David Kaminski-Morrow London

Analysis of airborne conflicts in core European airspace has revealed that a substantial proportion of collision-avoidance manoeuvres are not flown correctly after on-board systems issue resolution instructions.

Eurocontrol has published the findings of an assessment covering 12 months of operations and examining 1,184 resolution advisories – automated orders to pilots from collision-avoidance systems intended to de-conflict aircraft and restore safe separation.

Some 64% of the advisories were “level off” instructions, typically issued when a rapidly-climbing aircraft is approaching its cleared altitude while another aircraft is present at an adjacent level. Another 23% of advisories were instructions to “climb” or “descend”.

Shorter alerts were filtered out. The 1,184 advisories examined had lasted 8s or more, with just over

1,000 lasting at least 12s, and 823 lasting 16s or more.

“The study has shown that a significant proportion of [advisories] are not flown correctly,” the analysis states.

Compliance varies depending on the type of advisory and duration. The analysis found that the level of correct compliance with the first advisory, after 8s, was only 38% – with nearly 24% of advisories not followed and 33% followed in the opposite direction.

While compliance with some types of advisory improved if it lasted 12s or longer, corrective “climb” and “descend” instructions were “frequently not followed correctly, regardless of their duration”, the analysis says, with compliance never exceeding 30%.

33%

Proportion of advisories followed in the opposite direction

About half of pilots did not achieve the required vertical rate in response to “climb” or “descend” orders, despite a “generous” margin granted by the analysis, while the level of opposite reactions reached 22%.

“Opposite reactions are the most critical cases from the safety point of view,” the analysis points out.

Eurocontrol admits that the study is “not well placed” to determine directly whether safety is degraded when pilots do not follow the advisories correctly.

“However, it can be assumed that any incorrect responses to [advisories] may fail to resolve a collision,” it adds. “The study found a number of cases where, in the absence of correct pilot response, vertical separation at the closest point of approach was significantly reduced.”

Insignificant?

But it acknowledges that the relative infrequency of these cases – and other factors which affected the vertical separation – meant the analysis could not obtain statistically-significant conclusions.

International pilot association IFALPA and air traffic controller counterpart IFATCA have expressed dismay at the findings, stating that the trend of non-compliance “remains alarming”.

“While resolution advisories are rare events, when they happen the situation may be critical, and correct action must be taken promptly,” they add.

Pilots should always follow an advisory and – in any case – should never manoeuvre in the opposite direction, says IFALPA, adding that crews should not assume an aircraft visible from the cockpit is the same one displayed on collision-avoidance systems.

Controllers should be informed that advisories are being followed, in order to prevent possible conflicts of instructions. IFATCA adds that pilots should not be told to maintain vertical rates until a cleared level unless necessary, as this limits their flexibility to reduce closure rates and reduce nuisance “level off” advisories.

Operators should consider making advisory responses a focus for recurrent training, the associations say, stressing that collision-avoidance alerts are supposed to be a “last resort” rather than a mechanism for separation assurance. ▶

Udvar-Hazy sees path out of crisis

Air Lease boss eyes industry rebound and outlines why Boeing should rename the Max – and what it should build next

Jon Hemmerdinger Tampa

You would have a hard time finding anyone who has travelled as much in recent months as Steven Udvar-Hazy.

Destinations recently visited by the executive chairman of Los Angeles-based Air Lease include numerous countries in Europe, where he has met with various airline customers.

The meetings helped Udvar-Hazy, whose company is among the world's largest aircraft lessors, keep a finger on the global airline industry's pulse.

He also experienced, first hand, stark differences in how various countries have responded to the coronavirus. Those differences exemplify precisely why nations have struggled to implement standard Covid-related travel and testing protocols.

Udvar-Hazy believes more airlines may fall victim to the downturn seen in 2020. But he suspects most global network-style carriers will survive, and he is encouraged by predictions of a rebound in mid-2021.

As for the aerospace sector, Udvar-Hazy sees particular uncertainty coming from Boeing. A man who has long influenced development of new jets, he questions whether Seattle now has the resources needed to develop a compelling rival to the Airbus A321neo.

"What I would like Boeing to build and what they can build, and afford to build, are two different things," Udvar-Hazy tells FlightGlobal.

But first – his travels. A Hungarian immigrant to the USA, 74-year-old Udvar-Hazy holds both US and European passports, which, in the age of a pandemic, means he can travel more freely than most.

Here's how he describes the responses he's seen to Covid-19 across Europe.

Amsterdam: "Things were kind of loose... A lot of people were not wearing masks... really open." Germany: "Pretty strict." Stockholm: "I didn't see one person wearing a mask... It was just business as usual." Portugal: "Very much restricted, and masked."

Substantial recovery?

Faced with that patchwork of restrictions it is "really hard to get unanimous regulatory framework in place," he says.

In recent weeks, Udvar-Hazy says, he has talked with executives at more than 100 airlines. And many – particularly those in Europe – suspect some form of substantial recovery could come by mid-2021.

"By the middle of next summer – that's the same thing I'm hearing from most of the European CEOs," Udvar-Hazy says.

No-one is predicting such a rebound in the international, long-haul segment. But the prospect of so many people travelling on short-haul flights within six months feels



Leasing chief believes more airlines may go under as a result of the pandemic

much more optimistic than previous predictions, which put recovery much further out.

To date, the Covid-19 slump has claimed surprisingly few airlines. The collection of unfortunates – and not all ceased service solely because of Covid-19 – largely comprises small airlines and subsidiaries of larger carriers. Among them: AirAsia Japan, LATAM Airlines Argentina, NokScoot, South African Airlines, SunExpress Germany, and US regional carriers Compass Airlines, ExpressJet Airlines and Trans States Airlines.

Udvar-Hazy thinks additional failures are possible, citing Scandinavian budget carrier Norwegian as an example. The airline has



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Billy Pix

initiated formal financial restructuring in both its home country and in Ireland, where its Norwegian Air International and Arctic Aviation Assets subsidiaries are based.

"AirAsia X is on the intensive care list," Udvar-Hazy adds. And he suspects Mexico's Interjet may not survive the downturn either.

Canadian leisure airline Air Transat is also "a little bit vulnerable", especially if a planned acquisition by Air Canada falls through and if Ottawa fails to approve an airline rescue package, Udvar-Hazy warns.

But, in his view, most "national flag carriers" and other traditional network-style long-haul international airlines will likely muddle through the pandemic thanks to various forms of government aid.

"The probability of one of those large intercontinental network carriers going out of business is very remote," Udvar-Hazy says.

Latin American airlines have been less successful in securing government assistance, but Udvar-Hazy suggests carriers such as Avianca, Gol and LATAM will weather the storm.

Although the industry's woes have led airlines to push off aircraft deliveries, Udvar-Hazy doubts demand for new jets will remain depressed for long. He notes that following the financial crisis of 2008-2009, "airlines were bent on growth and getting more market share".

Air Lease had outstanding orders for 372 Airbus and Boeing jets as of the end of September, according to a recent regulatory filing, with a further 308 already on its books.

Final flights

The pandemic has prompted airlines to retire huge fleets of aircraft. First, they accelerated the demise of types already on the chopping block, before also dispensing with newer models, for instance A380s.

"All of a sudden there was a massive retirement cycle," Udvar-Hazy says.

And carriers are not only flying fewer aircraft - they are flying, on average, smaller jets. Udvar-Hazy suspects the number of seats per departure in summer 2021 will be 25% lower than in summer 2020.

At the moment, airlines have no use for those lost seats, but they will when the recovery takes hold, he suspects.

That's one reason Udvar-Hazy thinks that the 737 Max will rebound from its 20-month grounding and reputational crisis. He has good reason to hope so, as Air Lease is among Boeing's 737 Max customers. It had 15 of the jets and another 107 on order at the end of September, according to financial reports.

Udvar-Hazy notes that hundreds of airlines collectively operate thousands of 737s - a "tremendous embedded fleet", which at some point will need replacing.

"There is a base of customers [for whom] the natural migration is to go to the Max," Udvar-Hazy says.

He is among those who think the "Max" name, synonymous as it is with two fatal crashes and a lengthy grounding, should be scrapped in favour of the simple 737-8, -9 and -10 designations.

Boeing's Max orderbook has taken a beating amid the dual pressures of the grounding and

the pandemic. In 2020 through to end-October, customers had logged some 450 Max cancellations, while Boeing stripped from its backlog another 600 Max that it doubts will sell, owing to the financial condition of certain customers.

The changes have wiped 1,040 Max orders from Boeing's books – about one-quarter of its pre-2020 Max backlog.

More than 300 of the cancelled orders came from lessors. Air Lease has cut its Max orders by 28 this year, converting some to 787s, publicly available figures show.

But good news came on 18 November, when the US Federal Aviation Administration (FAA) lifted the Max's grounding. Airlines can now resume flights after updating jets and running pilots through new training.

Boeing can also now resume deliveries, though at what pace remains to be seen. Neither Udvar-Hazy nor some industry analysts suspect Boeing will produce the Max at anywhere close to its pre-grounding rate of 53 jets monthly. At least not any time soon; perhaps never.

Chinese influence

Udvar-Hazy suspects demand will support monthly production of 25-30 Max for the next three to four years, but adds that Boeing's rates will partly depend on Chinese carriers, which could account for 30% of the Max's sales potential.

US-China trade and diplomatic relations have soured in the past few years, raising uncertainty about whether China's airlines will ultimately take delivery of so many Max. Intertwined with that uncertainty is the question of how quickly, and under what conditions, China's regulator will lift the Max's grounding. Further complicating matters: China continues developing and promoting a home-grown competitor, the Comac C919. "All eyes on China," Udvar-Hazy says.

"If Boeing does anything, it has to leapfrog Airbus. It can't just be status quo against the A321... it has to be a superior plane."



Boeing

Air Lease has cut its Max orders by 28

He suspects 787s will continue selling well, as will A350-900s, but says lack of demand for very large ocean-crossing jets raises questions about types like the in-development 777X.

Udvar-Hazy views Boeing's competitive position against Airbus as having eroded in recent years. The European airframer has scored big with its popular A321neo – particularly with long-range variants of that jet that can operate transatlantic routes. The A321XLR, scheduled for service entry in 2023, will have capacity for 244 passengers in a single-class layout, and 4,700nm (8,700km) range.

By comparison, Boeing's largest Max – the 737 Max 10 – will carry up to 230 passengers and have 3,300nm range. Smaller Max variants have additional range but can carry fewer passengers.

"We definitely see the market share tilting in Airbus's favour, but we do see a future for the Max," Udvar-Hazy says.

Boeing's next move remains uncertain. And the pandemic might alter which specifications airlines will seek, Udvar-Hazy says.

"It's kind of hard to define what the right sizing is, because we don't know how the global economy will

recover," he says. "Boeing needs to... be ready to launch a plane when things stabilise."

He suspects airlines will still need a family of new jets fitting within the middle-market segment – where the A321XLR will sit and currently occupied by elderly 757s and 767s.

Udvar-Hazy suggests a jet with 170-250 seats might be ideal, slightly fewer than the 200-270 seats – and 4,000-5,000nm range – Boeing was eyeing for its now-ditched New Mid-market Airplane (NMA).

Standing apart

Capacity aside, if Boeing expects to wrest back a market-leading position, its next aircraft must stand apart from anything currently offered by Airbus, Udvar-Hazy says.

"If Boeing does anything, it has to leapfrog Airbus. It can't just be status quo against the A321... it has to be a superior plane."

That could mean a jet with expanded use of composite materials, or with engines incorporating advancements in hybrid-electric technology. Electric "augmentation" could theoretically assist gas turbines during certain phases of flight. But such a project won't come cheap: Udvar-Hazy pegs the development cost at \$10-15 billion.

Whether Boeing is up to job – or will be any time soon – remains an open question, considering its financial position and significant workforce cuts.

"My fear is that Boeing is distracted and they have lost a lot of their good career engineers," Udvar-Hazy says. "They have been bruised and battered so badly." ▶



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Eviation Alice blaze involved Li-ion cells

Incident early last year that destroyed prototype electric aircraft in Arizona took place after hours of engine testing

Jon Hemmerdinger Tampa

A January blaze that damaged Eviation's Alice prototype ignited after hours of powerplant testing, involved lithium-ion batteries and forced the aircraft's three occupants to evacuate, according to detail contained in fire incident reports.

Before exiting the aircraft, the team – which apparently included staff from flight certification company AeroTEC and electric motor maker Magnix – noticed that Alice's battery box was hot. The battery subsequently "exploded" according to the US Federal Aviation Administration (FAA).

The specifics of the incident are included in fire reports received by FlightGlobal from the Prescott, Arizona government.

The 22 January 2020 blaze occurred at Prescott Regional airport, where Israel-based Eviation had been evaluating the ground-test article.

Alice is an in-development, nine-passenger, all-electric business and commuter aircraft. It has three propellers powered by a 920kWh lithium-ion battery pack, and promises a 440nm (815km) range and 220kt (407km/h) cruise speed.

"Small electric aircraft heavy smoke," a Prescott fire department report says of the blaze. "Owner stated that we would not be able to extinguish due to the heavy Li-ion battery load". The fire originated in the aircraft's "operator/passenger area", the report says, but does not specify a cause.

"Further examination of the aircraft is needed, to be performed by qualified individuals, in order to determine the exact sequence of events through which the fire started," says a separate investi-

gation report from Prescott fire inspector Bret Lucas. "The cause of the fire is undetermined."

Eviation declines to comment on the fire or on the timeline for Alice's development.

Owing to the nature of the test aircraft, the FAA did not investigate the incident. "While the incident was reported to the FAA, the aircraft in question was a non-certified prototype that was not intended for flight," the agency says.

However, a separate FAA lithium-ion battery "event" report mentions the incident.

"A lithium battery used to power an experimental aircraft exploded at Prescott airport," it says.

Rigorous testing

In January, Eviation issued a short statement saying that the fire was "believed to have been caused by a ground-based battery system which was being utilised during rigorous testing of its all-electric airplane".

The Prescott fire department received the fire alarm at 18:29 local time on 22 January. Firefighters



from a nearby station arrived on the scene 6min later, a report shows.

"Owner asked if we could just protect the exterior of the fuselage," the report says.

The team "provided protection to fuselage with master streams" but also sprayed inside the "fuselage to cool the remainder of the batteries".

"Upon arrival I observed a white three-engine airplane parked in front of a closed door hanger," says the fire inspector's report. "I ob-





BillyPix
First flight was previously scheduled for 2020

served soot and burn marks on the window and door areas."

"A possible malfunction occurred of the aircraft battery system while the engines were being tested, which resulted in the fire," the fire marshal said, according to the inspector.

Test crew

Three people were aboard Alice when the fire started: pilot Steve Crane, who sat in the captain's seat, engineer Andrew Blanchard, who was beside Crane, and engineer Jonathan Johnson, who sat in a rear-facing seat behind Blanchard, the report says.

"They had been testing the two wing engines off and on since noon," it says. "At about 17:40, they started up the engines and continued to test them as they did all day."

At about 18:25, Johnson "noticed a slight temperature rise of one of the battery cells, but said that it was still within normal operating temperatures."

"He got out of his seat and went to the battery box. He felt the box, noticing it was getting hot, then he turned back and noticed gray smoke coming from under his seat," says the inspector's re-

"A possible malfunction occurred of the aircraft battery system while the engines were being tested, which resulted in the fire"

Prescott fire department

port. "Johnson called out, 'Smoke, smoke, smoke', and then, 'Get out, get out, get out!'"

Johnson pushed an "emergency stop button" and Crane put the throttles in neutral.

"All three then exited the plane via the port door," the report says.

Documents do not otherwise identify the people involved. But LinkedIn shows a Steven Crane as chief test pilot at AeroTEC, and an Andrew Blanchard as flight-test engineer at that company; Washington state-based AeroTEC is a partner on the Alice project.

The fire report also says a technician named Bryce Aberg was at the scene. LinkedIn lists Aberg as a power electrics engineer at Magnix.

Eviation named Magnix and Siemens - now Rolls-Royce - as propulsion system providers, while GKN, Honeywell and composite specialist Multiplast are also involved in the programme.

Batteries are to be provided by South Korean firm Kokam. US airline Cape Air is the aircraft's commercial launch customer.

Eviation intended for Alice to make a first flight in 2020, followed by deliveries in 2022, but has said little since the fire. However, an October press release from a supplier to the programme - Altitude Aerospace - gives 2021 as the date for the maiden sortie.

Given the ambitious nature of the programme, obtaining certification in such a short period of time seems extremely challenging. ▶

Faster than sound

The first person to fly at supersonic speed, and a double fighter ace, Chuck Yeager was 'America's greatest pilot'

Aviation pioneer Brigadier General Charles 'Chuck' Yeager passed away on 7 December 2020 at the age of 97, almost three-quarters of a century after claiming one of the greatest firsts of the post-Second World War era.

Announcing his death "with profound sorrow", Yeager's wife, Victoria, said his was "an incredible life well lived". She describes him as "America's greatest pilot, and a legacy of strength, adventure, and patriotism will be remembered forever."

Yeager's status as an aviation icon was assured in tight secrecy on 14 October 1947, when he became the first pilot to break the sound barrier. His Bell X-1 rocket plane, nicknamed "Glamorous Glennis", achieved a top speed of Mach 1.06, after being dropped from a Boeing B-29 bomber.

However, his fame was not instant, with the historic achievement confirmed officially only in June 1948.

Referring to media reports which spread towards the end of 1947 speculating that a supersonic flight had been made, *Flight's* 29 January 1948 editorial noted: "These were only rumours to start with, but when connected together with apparently unconnected happenings it became obvious that something remarkable had occurred. Yet the secrecy ban still remains. In the end, the technical press could bear it no longer, and one aviation paper came out with a definite but unconfirmed statement.

"The air force... were obviously upset by it, inasmuch as they are said to have handed the whole matter over to the Department of Justice to see if any security measures had been violated," our report continued. With such a potential legal threat in mind, it said: "Until the air force decide to release details of what has actually happened, it is foolish to make guesses... but if reports are true it would seem that the sonic 'barrier' wasn't such an insurmountable

one after all. That alone is a fact of the greatest importance."

Beneath a front-page headline "Faster than sound", *Flight's* 17 June 1948 edition noted: "Now that no less a person than Mr Symington, American Secretary for Air, has given confirmation of this performance, we must hasten to tender our congratulations jointly to Captain Charles E Yeager and the Bell Aircraft Corporation."

12.5

Number of combat victories flying P-51 Mustang in Second World War

Clearly frustrated by the continued secrecy surrounding the event, our report speculated: "Whether supersonic speed was first achieved in conformity with a long-term programme, whether it occurred by accident or whether the pilot was suddenly overcome by a desire to "give her the gun", is not yet known, but, whatever the circumstances, the achievement ranks as one of man's most remarkable technical accomplishments."

In a 1991 interview, Yeager disclosed how he felt at the moment when his X-1 was released.

"You don't feel anything. You are too busy. You are going through your checklist, loading the pressure regulators, the dome and checking all the instrumentation. And that's about the way of it. You listen to the B-29, he is hauling you up, and you start diving to pick up speed. You are heavy, and it's a compact little airplane, and you come out of a dark place into bright sunlight, and for a second you're kind of blinded."

Breaking the sound barrier saw Yeager win the Collier Trophy in 1948. "This is an epochal achievement in the history of world aviation – the greatest since the first successful flight of the original Wright Brothers' airplane, forty-five years ago," said the words accompanying the trophy.

Yeager's route to the cockpit began after he enlisted as a mechanic in the US Army Air Force during the Second World War.

"There was no intention to be a pilot, or anything like that. When I got in, in September of 1941, I was trained as a mechanic, which was easy. I had already had so much experience in mechanical things,



An 89-year-old Yeager broke sound barrier again in 2012, in the back seat of an F-15D

US Air Force



US Air Force

Yeager's supersonic flight in his Bell X-1 rocket plane was kept secret for months

like engines and things that dad exposed us to all the time, that I trained and began working on airplanes as crew chief. I serviced them, overhauled the engines, and things like that."

Subsequently, he spotted a notice on a bulletin board calling for pilots and decided to apply. He graduated from training in 1943.

He was deployed to Europe, flying the North American P-51 Mustang, and was shot down in March 1944, before escaping capture and rejoining the fight. In all, he scored 12.5 combat victories, making him a double ace. His achievements including downing five Messerschmitt Me-109s in a single day, and four Focke-Wulf Fw 190s on another.

Post-war, Yeager "aided in pioneering modern aircraft development during his nine-year assignment as an experimental test pilot by test-flying numerous experimental, production, and foreign aircraft for the US Air Force [USAF]," the service says. "This included taking the X-1A to Mach 2.44 in straight and level flight on 12 December 1953."

He subsequently held a number of operational and flight-test roles

with the USAF, including logging 127 missions over South Vietnam, while based in the Philippines. He rose to the rank of Brigadier General, before retiring from the military in 1975, having flown 155 different aircraft types.

He held a number of corporate and consulting roles, and continued flying in a private capacity. His story was included in the 1983 film

The Right Stuff, in which he made a cameo appearance as a barman.

In 2002, Yeager enjoyed a back-seat flight in a Boeing F-15 from Edwards AFB in California – from where he had flown the X-1 to fame.

Quoted in a *Boeing Frontiers* publication report, he had solid advice for any current or would-be aviator: "It's not being a good pilot that keeps you alive. What keeps you alive is knowing your airplane. I always wanted to know more about the airplane and its ejection seat than the guys who made them."

A full decade later, the then 89-year-old Yeager broke the sound barrier for the last time in the back seat of an F-15D, flown from Nellis AFB, Nevada, 65 years to the day after his historic first. Having enjoyed the ride, he noted: "The F-15 is my favourite airplane. That's why I came here to fly it."

Yeager was highly active on Twitter in his latter years, sharing his experiences and engaging with those fascinated by his achievements and acquired knowledge, remaining an inspiration to the end. ▶



Faster Than Sound

LAST Thursday, after relating how the Colour has not been present at the meetings of the Royal Aeronautical Society for some time, we were gratified to learn

that a tall piece of an American aircraft has finally been added to the list of exhibits. This was the Bell X-1, which won a Test Match and, incidentally, England has won a Test Match.

Yeager, the pilot named, has given a short account of the most important events in the sensational history of mechanical flight, for so long ago as last December

a press reporter asked him if he had ever heard of the 'Mach' and was quoted throughout the world to the effect that he had not. The reporter then asked if the aircraft had achieved supersonic speed, and once, but since he had not done so again, he had not thought of it.

When asked if he had ever heard of the 'Mach', he said he had not, but when asked if he had ever heard of the 'X-1', he said he had.

With the exception of the X-1, which was achieved in conformity with a long-term programme, whether it occurred by accident or whether it was and still is every man's ambition to give the colour to the sky, is not yet known, but, whatever the circumstances, the achievement is one of the greatest in the history of technical accomplishments.

Next Generation Pilots

THE overall result of flight training, including the fitting of aircraft to be used for the job, is to occupy many minds in Ministries and industry and has recently been occupying many pages in this

journal. Something of a turning point has been reached, and many reforms and new ideas are on the verge of being adopted. The question is, however, whether they are all concerned. In recent months setbacks and blows have been suffered by the industry, and the most disappointing of all, after early high hopes and expectations, is the fact that the Government has refused to aid the private flying movement in any way whatsoever.

It is to be hoped that the Government will now take steps to encourage the growth of the private flying movement, and with cost of flying reduced, the public will be more inclined to fly.

In a short while we may expect to have details from the Ministry of Civil Aviation concerning the proposed renewal of pilot's licences and of qualifications for flying the new aircraft. We hope that the changes will be in existing regulations, but it is regrettable that the standardising amendments for licences must necessarily put the new aircraft into a separate class.

The light aircraft of the type suggested by the Maudslay Committee, will be a welcome addition to the civil market, at least for some years. It is to be hoped, however, that the Government will not be too hasty in its decision to withdraw the grant of £100,000 per year to which we have been reintroduced in the last week.

It is to be hoped that the Ministry of Civil Aviation will have a more encouraging reception.

Charles "Chuck" Yeager

13 February 1923 – 7 December 2020



SpaceKris/Shutterstock

Looking past the pandemic

Cirium's **Chris Seymour** outlines the adjusted outlook for an industry coming to terms with the impact of Covid-19

Cirium's latest long-term market forecast reflects the impact that the coronavirus crisis is having on the industry, but still foresees strong demand for airliners over the next 20 years.

Following 10 consecutive years of uninterrupted growth, the crisis has led to an huge reduction in global traffic and heavy industry losses.

The 2020 Cirium Fleet Forecast predicts delivery of 43,315 new airliners (including 1,010 factory freighters) worth \$2.8 trillion over the next two decades. Passenger traffic, measured in revenue passenger kilometre, is forecast to grow at 3.3% per year and cargo traffic, in freight tonne kilometre, at 3.6%.

But our latest delivery forecast is 8% lower than last year's. The retirement forecast has also been accelerated following the virus, with the number of aircraft being removed from service 33% higher in the near term than we predicted previously.

The crisis in 2020 has driven worldwide airliner deliveries down by more than 50% against 2019; this year's total will also be the lowest in 25 years. However, the aviation industry has proved resilient to previous downturns and external shocks.

Our traffic modelling uses a scenario approach for this year's forecast, specifically 2020-2024. This

assumes traffic will level off at 60-70% lower than 2019 into the first part of 2021, before a slow recovery towards 2024 when pre-Covid traffic levels are achieved again.

Beyond 2024, we therefore expect to return to more traditional growth paths, but with that modelling starting from the perhaps structurally different industry we may find at the end of the recovery.

Deliveries should surpass the previous peak (in 2018) during 2025 and the annual delivery value will not recover to over \$100 billion again until 2024. It will then rise to over \$170 billion by the mid or late 2030s. By then, we forecast annual deliveries at around 2,600 aircraft.

Supply and demand

For the foreseeable future, supply of aircraft will substantially outstrip demand. Just over half of all passenger deliveries will be for replacement during the 20 years, with a higher level of 75% during the first five years, as the level of deliveries has reduced and retirements increase in the lower traffic environment. We estimate that more than four-fifths (82%) of today's global fleet will be retired from passenger service during the 20-year period, with many coming in the early years from the current surplus fleet.

Slightly fewer freighters will exit the market (74%), due to their longer economic lives. Overall, there will be over 21,600 retirements.

In terms of demand by region, Asia will continue to set the pace. China is forecast to have the highest 20-year annual passenger-traffic growth rate, at over 6%. This will make it the largest single country for deliveries with a 22% share, ahead of all other Asia-Pacific countries with a combined 21% share.

North American airlines follow with 20% and Europe with 16%. The Middle East will account for 6% in units, but the high number of twin-aisles represents 10% in value terms.

Most of the global long-term market will be covered by Airbus and Boeing, between them accounting for over three-quarters of deliveries and 86% of dollars through 2039.

In the passenger market, single-aisle jets will account for 67% of deliveries and 54%, or \$1.5 trillion, of value. The \$1.1 trillion twin-aisle market will see 7,000 aircraft delivered, predominantly Boeing 787s and Airbus A350s. Twin-aisle supply will remain the last duopoly in the commercial sector until the turn of the decade, but China and Russia have launched the 300-seat CR929 and there are 800 deliveries forecast for this or unspecified twin-aisles from existing and new programmes.

We forecast almost 6,900 deliveries in the regional sector worth \$175 billion. Regional jets will account for 60% of deliveries, but among the 2,700 turboprops forecast, a larger 90-plus-seater could arrive from the 2030s.

Freighter markets will continue to see a 70% to 30% split between conversions and new deliveries, with total demand for over 3,300 aircraft, including \$115 billion for 1,010 new aircraft, plus 2,375 conversions. The latter will be driven by the growth of e-commerce, which has been boosted during lockdowns. Some of the passenger aircraft retired during the forecast will transition to the freighter fleet after conversion. Overall, the freighter fleet will grow at almost 2% annually to reach 4,100 aircraft by 2039. ▶

Chris Seymour is head of market analysis at Ascend by Cirium

Forecast deliveries 2020-2039

Turboprop	2,745
Regional jet	4,110
Single-aisle	28,450
Twin-aisle	7,000
Freighter (new)	1,010
Total	43,315

Source: 2020 Cirium Fleet Forecast

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2021 forecast: What shape will recovery take for aviation?

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Keeping pilots in the fight

Don't expect future combat aircraft projects to eject human crew, says

Douglas Barrie

The extent of the economic impact of the Covid-19 pandemic, besides the tragic and continuing loss of life, can only begin to become more clear during the course of 2021.

Defence expenditure will, irrespective of the uptick in UK funding, not be exempt. Cancellations, cuts, and programme delays are all likely to feature as countries attempt to absorb the economic damage. Air forces will not escape the pressure, but do not expect to see next-generation combat aircraft developments shelved willy-nilly as a result.

There are at least eight tactical combat aircraft projects under way today: two in the USA, three in Europe and three in the Indo-Pacific region. Irrespective of their stages of development, all are designed around a cockpit, putting paid to any notion that the era of the crewed combat aircraft is at an end.

Several factors continue to keep the ejection seat and its occupant, or occupants, in the designs now being worked on. Air power remains dependent not only on technology and innovation, but also on people. There is also a strand of conservatism that when coupled with the investment required runs counter to risk taking: particularly if the project is at the core of an air force's future combat fleet.

More important in the crewed versus uninhabited debate is that the pace of progress on the latter has been slower than many anticipated. There have been numerous false starts in the development and introduction into service of high-end unmanned combat air vehicles. Sim-



Airbus Defence & Space

Next generation of strike assets will be complemented by unmanned systems

pler unmanned air vehicles fitted with air-to-surface munitions have seen wider and ongoing adoption.

Autonomy, rather than increased automation, remains a challenging goal, and technical, legal and ethical issues all remain to be navigated, successfully or otherwise. Uninhabited systems in the near-to-medium term will complement, rather than replace crewed platforms.

The worsening security environment combined with the risk of peer or near-peer war is also reinforcing interest in high-end air domain capabilities. A war between post-industrial nations would involve kinetic and non-kinetic activity across all domains, with the ability to contest and operate in the air (and in space) fundamental to the outcome.

Sustaining superiority

The capacity to ensure air superiority remains a tenet of the 'Western way' of war. This, however, will likely not reflect the air supremacy or air dominance envisaged in the past. Rather, it will be based on the ability to sustain air superiority in a given space for a given period of time to prosecute a mission or to act as an operational enabler.

The permissive air environments of recent wars that have involved the USA and its allies will, in a peer-on-peer conflict, be replaced by high attrition rates. The gap in capability between the USA and its competitors has narrowed – particularly in the case of China, viewed by Washington as its 'pacing threat'.

The US Air Force and US Navy are now looking at their next generation multi-role fighter needs, with

the geography of the Indo-Pacific a potential requirements driver. Combat radius will likely be of increased importance and coupled with the aim of carrying more weapons internally, this means the platform will be no smaller, and possibly larger, than the current generation.

One implication of this is that the USA's next-generation fighter programme may not produce a Lockheed Martin F-16- or F-35-style platform easily accommodated also as an export product.

Europe has its own challenges in this arena. A failure to adequately consolidate the defence aerospace industry has left Europe pursuing three – if Turkey is included – combat aircraft developments.

France and the UK, despite the rhetoric of the 2010 Lancaster House defence co-operation agreement, remain unable to align defence-aerospace requirements and industry. France is leading the New Generation Fighter with Germany and Spain as partners, while the UK is heading the Tempest project with Italy and Sweden supporting. Both are nested within wider Future Combat Air System projects also including adjunct uninhabited systems and weapons.

Whether current European multi-national constructs are the same as those that may deliver the next generation is also open to question. But what is not in doubt is that there will be crew in the cockpit. ▶

Douglas Barrie is senior fellow for military aerospace at the London-based International Institute for Strategic Studies.



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ATR

FedEx Express received its first factory-built
ATR 72-600 Freighter, from a 30-unit order

Best of the rest

We showcase some of the other notable events covered by the FlightGlobal team between issues



Dassault rolled out its new Falcon 6X – the twinjet is due to get airborne in early 2021

Dassault



Stephan Widmer

Pilatus conducted first flight of a PC-21 trainer produced for the Spanish air force



United Aircraft

Power switch: Irkut tested MC-21 with Russian PD-14 engines, moving from PW1400Gs



Virgin Australia

Virgin Australia will return as 'mid-market carrier', following its sale to Bain Capital



Boeing

Boeing's MQ-25 Stingray demonstrator flew with an in-flight refuelling pod installed



Airbus Helicopters

Berlin signed for 31 NH90 Sea Tigers, to be tasked with anti-submarine warfare duties

Next month

How
did safety fare
during 2020?
Don't miss
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FLIGHT
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On sale
4 February



Plus...



ATR

Cargo lift

How air freight operators and manufacturers are adapting to changing market needs



Airbus

Bad times

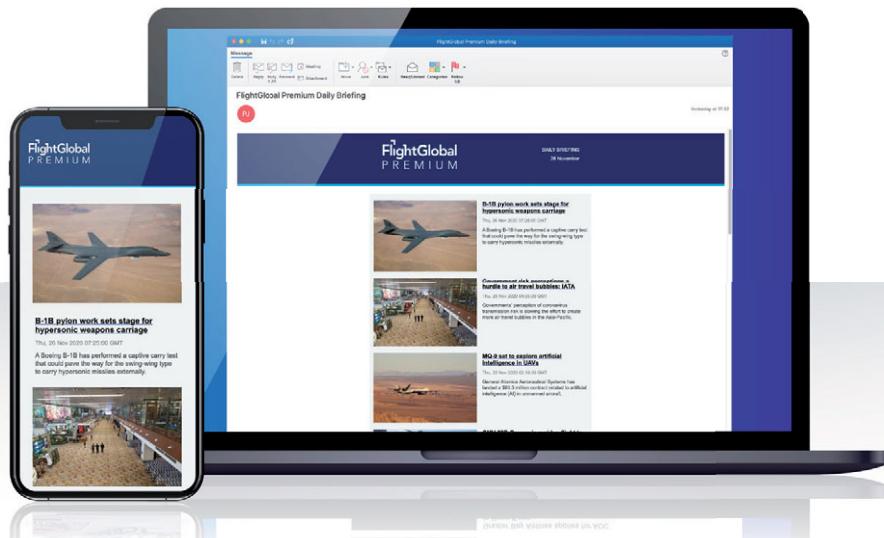
We analyse a troubled year for commercial orders and deliveries

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Back on course

It has been an annus horribilis for forecasters – including FlightGlobal's. The pandemic that swept the world in the first quarter of 2020 and the ever-shifting legal restrictions on our liberty to work, shop, socialise, and travel that have followed have made predicting what might happen in aviation and elsewhere the following week, let alone in 12 months, the most inexact of sciences.

So it is in a spirit of humility – yet uplifted by the real prospect of a Covid-19 vaccine becoming widely available over the next few months – that our team turns its sights on what 2021 might hold in store. None of us knows how the fight against the most economically-damaging phenomenon of most of our lifetimes will go. But we dare to believe that the coming year will be better than the one just gone. Here are our 2021 forecasts.



2021

Max crisis

Consolidation

Boeing's way out

The airframer received a boost when its 737 Max was approved to return to service. But it faces a huge task to recover from Covid and a two-year grounding

Jon Hemmerdinger Tampa

Boeing's troubles are far from solved, but the events of 18 November 2020 at least cleared a cloud that had been over the airframer for 20 months.

On that day, the US Federal Aviation Administration (FAA) lifted the 737 Max's grounding, enabling airlines to resume flights and Boeing to restart deliveries.

For that reason, 2021 starts with a rare (if narrow) beam of optimism for the Chicago airframer, though the company must still muddle through an industry collapse that poses unprecedented challenges.

Several aerospace analysts have predicted that Boeing will not announce any major commercial aircraft development projects in 2021, but will instead focus on weathering the crisis.



Company has a significant inventory of 737s awaiting delivery

The long goodbye

Despite the sustained downturn, very few airlines have actually gone out of business. Could 2021 see a reckoning?

Graham Dunn London

One of the most striking aspects of what is the deepest and most sustained crisis ever to hit commercial air transport is that it has resulted in relatively few airline collapses thus far.

The relatively small number of airline failures, however, is not indicative of the health of the sector. Quite the opposite. It reflects that the sheer scale of the crisis means states have been forced to introduce financial measures, either direct or indirect, to help support airlines through the crisis.

Virgin Australia in August shut down low-cost unit Tigerair Australia, citing insufficient demand to support two players in the market – one in which Jetstar also operates.

Where states have been reluctant or unable to step in, formal restructuring processes have been launched in a bid to secure the necessary breathing space.

Many other carriers are undertaking major restructuring programmes, but outside of formal creditor protection processes.

To some extent the crisis has put airlines, almost regardless of their pre-pandemic health, into stasis. It will only be when the support measures are taken



Back soon? There has been interest in restarting the Flybe brand

track record, or at least a return on investment of some kind, will be a major consideration. Many airline brands, despite their long history, do not have a profits record to match.

Industry partners – notably aircraft lessors and manufacturers – have also played their part in supporting struggling airlines through the crisis. This of course is in their own interest – they do, after all, need airline customers at the other end of the crisis to fly their assets.

But lessors and manufacturers are businesses. They too will have to choose which airlines to back when a more normal business environment returns.

The stronger airlines have already been able to tap private capital or financial markets to generate additional liquidity through the crisis. That speaks to the improved balance sheets and investment returns parts of the industry have been able to deliver during the good times – and this illustrates that some will survive – potentially without the need for significant state support.

Others are likely to benefit too from circumstance: those with access to strong domestic sectors to fall back on or which operate in markets where there is better control of the pandemic or greater state desire to support a recovery of air traffic.

But when the plug on state support is pulled – and panic does set in – things can happen quickly. In Europe, after the financial crisis a decade ago, Malev and Spanair collapsed within a week of each other. The carriers had 90 years of flying between them, albeit with limited profitability.

It is inevitable more established airline brands will be lost as a result of the crisis. How many and how long it takes is another question altogether. Many brands may survive on a smaller scale – or as part of wider groups, depending on the appetite or ability of the stronger carriers to become acquirers.

But history suggests it takes a lot for an airline brand to disappear altogether. And as recent interest in a reboot of Flybe shows, or continued efforts to revive Jet Airways, even some lost brands may yet return. ▶

30%

Likely proportion of Max aircraft that could be bought by Chinese carriers

"What I really want to see in 2021 is solid management of the [deliveries] of the Max", and "some level of stabilisation with the 787", says Michel Merluzeau, aerospace analyst with consultancy AIR.

Among Boeing's primary 2021 tasks is finding a way to deliver hundreds of already-produced 737 Max. The company holds a stockpile of about 450 of those jets, and has said it intends to deliver about half of them within one year of the grounding being lifted.

"That's what is going to bring some level of liquidity back into the company," Merluzeau says.

But getting those jets into customers' hands may be no easy task because, at the present time, airlines have little need for more capacity.

"It's going to take creative thinking by Boeing in 2021 to work with customers", to convince airlines to swap out 15- to 20-year-old 737NGs with new Max, Merluzeau says.

Chinese question

And while FAA certification is a critical milestone, Boeing in 2021 will also probably be working to convince other countries' regulators to clear the jet.

While agencies in Canada, Brazil and Europe are expected to lift the Max's grounding relatively quickly, analysts have little clarity on when China's civil aerospace regulator will do so.

Analysts suspect China's clearance may be entangled within the US-China trade war and China's interest in promoting its home-grown, in-development Comac C919 jet.

"The re-certification in China remains a question and has been caught up in broader political discussions," ▶



2021

» says an 18 November report from financial services company Canaccord Genuity. The report adds that, political forces aside, Chinese carriers are probably eager to resume Max flights, owing to the relative strength of the Chinese air travel market.

Uncertainty about the Chinese market creates significant risk for Boeing, as Chinese carriers could account for some 30% of potential Max deliveries, Steven Udvar-Hazy, executive chairman of aircraft lessor Air Lease, tells FlightGlobal.

"[A] big question mark is China, which basically stopped importing 737s," he says.

In 2021, Boeing also intends to continue restructuring its operation to reflect the current aerospace environment.

By the end of 2021, Boeing expects to have about 130,000 staffers – about 19% fewer than it had at the end of 2019, chief executive David Calhoun told employees on 28 October.

New normal

Departing employees have included mid-level managers and vice-presidents in Boeing's commercial aircraft division.

The company is also slashing its real-estate footprint by up to about 30%, it has said.

Also in 2021, Boeing intends to cease production of 787s in Everett, consolidating that work at its manufacturing site in North Charleston, South Carolina.

Commercial aircraft production rates are also coming down. Boeing anticipates reducing output to six 787s and two 777s monthly in 2021, down from pre-pandemic rates of 14 and five, respectively. Boeing has not specified how many Max it expects to produce in 2021.

Some analysts think Boeing's ultimate output may be less than it has publicly projected.

"My primary area of concern is not necessarily the Max, it's the 787," Merluzeau says.

50

Examples of the 787 widebody type that are yet to be delivered

He cites particularly soft widebody demand and the likelihood that 787s may hit the second-hand market if the pandemic causes more airline failures.

In addition to the 450 737 Max in its inventory, Boeing is sitting on 50 undelivered 787s, Cirium fleets data shows. The company has acknowledged a slowdown in 787 deliveries owing to the pandemic and to required inspections stemming from an airframe issue disclosed in 2020.

Delivering five 787s monthly would be a "best-case scenario" for Boeing, Merluzeau says.

He suspects Boeing will actually manufacture closer to 50 787s in 2021 (about four monthly) and, on the more optimistic side, as many as 130 737s (about 11 per month). ▶

US air transport

Thinking differently

Airlines will continue to adapt their business models to cope with the changes of a market emerging from Covid-19

Pilar Wolfsteller Las Vegas

United Airlines turned heads in the late summer when it began planning numerous direct routes between northern US cities and sun destinations in Florida such as Orlando, Tampa, Fort Myers and Fort Lauderdale.

Coming from a legacy carrier that had for years found its fortunes in the more-traditional hub-and-spoke network, the move suggested to the market that the Chicago-based industry behemoth anticipates it will be quite some time until the industry finds its "new normal" following what will soon be a year-long coronavirus crisis.

The carrier launched the new flights – which originate in Boston, Cleveland, Columbus, Indianapolis, Milwaukee, New York and Pittsburgh – in November and December, and will operate them through the traditional US spring break period, which ends in April.

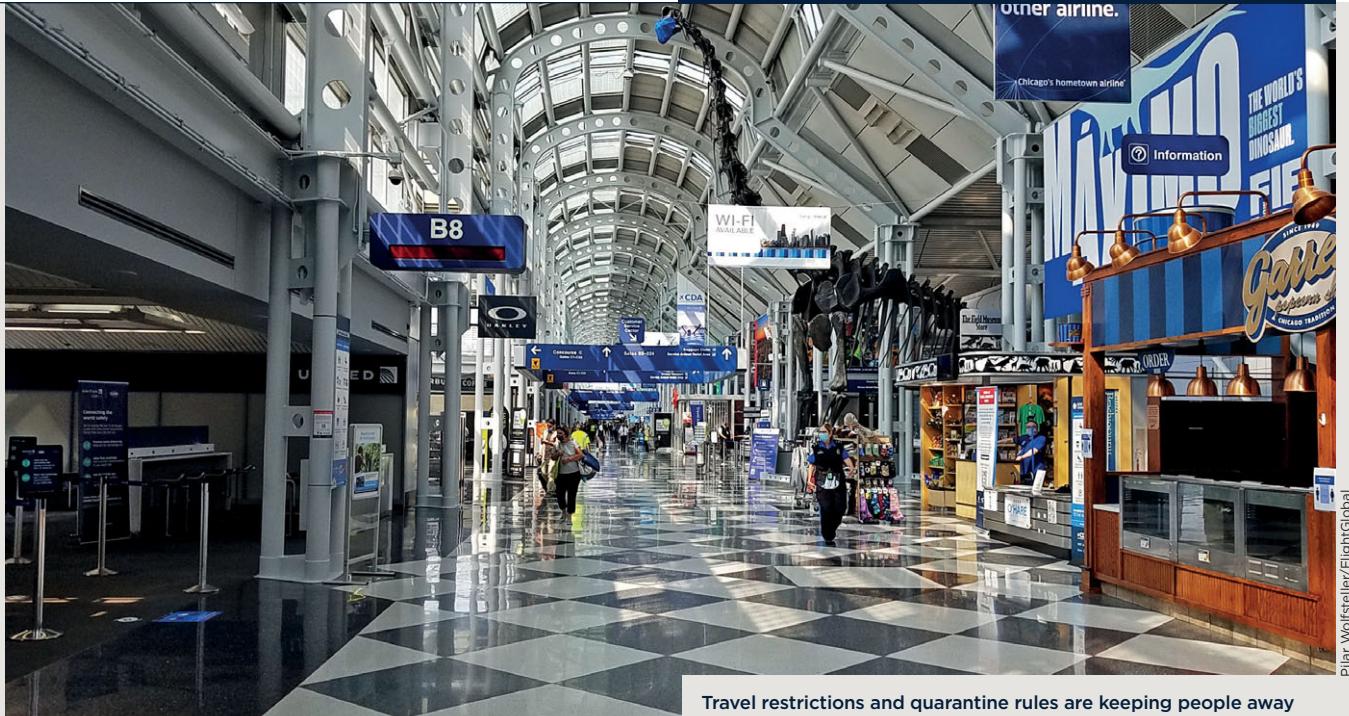
This partial departure from a traditional operating model in the coming cold-weather months, and possibly beyond, signals that US mainline carriers are trying new strategies to remain relevant and competitive, and to make up for lost business travel revenue. They may be doing so for quite some time.

"Carriers are out there trying to come up with other ways of generating revenue," says Stephen Trent, Citigroup's director of research for airlines in the Americas. "Point-to-point activity is consistent with that pivot, which, I imagine, could persist until we see a fairly meaningful pick-up in business travel and in international long-haul travel."

Don't start looking for that until the second half of 2021, he adds.

The new flights are designed to attract more potential winter-weary holidaymakers away from no-frills vacation specialists such as Spirit Airlines, Allegiant Air and Frontier Airlines.

They promise more comfort and eliminate the need to change aircraft in busy hub airports – a factor airlines hope coronavirus-cautious customers will find more attractive and less risky. It is part



Pilar Wolfsteller/FlightGlobal

Travel restrictions and quarantine rules are keeping people away

of a “proactive and demand-driven approach to offer more opportunities” for customers to get away from the damp, dark winter, United said at the time.

United is not the only US legacy carrier searching for business and revenue between the proverbial sofa cushions. In July, Fort Worth-based American Airlines announced a “strategic partnership” with JetBlue Airways, headquartered in New York, under which they propose to operate codeshare flights and offer reciprocal frequent-flier benefits.

The agreement focuses on flights in the northeast USA, particularly from Boston and New York.

The lights at the end of the tunnel may be getting more numerous, but also more distant

Mike Boyd President, Boyd Group International

The codeshares bring 60 new American routes into JetBlue’s network and 130 JetBlue routes into American’s operation, and allow customers to book those flights via either airline.

Alaska Airlines said in 2020 that it planned to join American’s Oneworld alliance as a full member by mid-2021, allowing American to connect flights through the Seattle-based carrier’s West Coast network.

“Even if the airlines are not directly offering [point-to-point routes], they are indirectly going that way in trying to use other airlines’ metal,” Trent says.

But uncertainties about the coronavirus and its impact on the passenger air travel industry remain.

Potential guests still face a patchwork of ever-changing travel restrictions, both abroad and within the USA. Numerous regions have re-imposed quarantine requirements as case counts rise, and the

longest peaceful border in the world, between Canada and the USA, remains closed for non-essential travel.

Vacation spots such as Mexico and Florida are mostly open, but public health officials worldwide continue to encourage people to stay at home in order to mitigate the spread of the virus. Popular attractions such as amusement parks either remain shuttered or have closed again in the wake of a third infection wave. Sports and cultural events have been curtailed or cancelled entirely. This makes planning a trip even more difficult as long as the pandemic rages on.

“The lights at the end of the tunnel may be getting more numerous, but also more distant,” writes Mike Boyd, president of Boyd Group International. “We have an airline industry that simply has not yet adjusted to the economic damage done.” With airlines currently possessing about 30% more aircraft than they actually need, they are in “survival mode”, he adds.

By the end of the second quarter of 2021, he says, the air transport system will be “very different and a lot smaller than was projected just nine months ago”.

But strategies such as adding direct routes and bringing modern, more-efficient aircraft – including the newly re-certified Boeing 737 Max – back into fleets, will help increase efficiency as the industry gets used to a more challenging money-making environment.

Airline industry observers agree that the availability of an effective and safe vaccine will be the kick-start the industry needs.

Even so, it will likely take the more-lucrative corporate travel segment another six to 12 months to return. Companies will need to re-think their travel policies, reconsider risks to employees, and reallocate budget.

“It could be the second half of 2021 until international long-haul and business travel start to spool up again in any meaningful way,” Trent says.

And any 2021 year-on-year comparisons will look like progress. Capacity and demand in the coming months will surely be above those in the early part of 2020, but that’s where the positive news ends.

“Going from 300 feet underwater to 100 feet underwater is a nice metric,” Boyd says. “But you’re still underwater.” ▶



2021

Tariff dispute

Subsidy slugging

Will the WTO judgement, a Biden administration and Brexit mean a new approach to the latest transatlantic tariff regime on commercial aircraft?

David Kaminski-Morrow London

Sixteen years after Boeing made its opening play in a transatlantic duel with Airbus over civil aircraft subsidies, the conflict has descended from legal sniping to a tiresome war of attrition, with each side underlining its claims of unfair government support while inflicting damaging tariffs on hundreds of exported products – commercial jets the most high-profile.

Neither side landed a knock-out but the US government arguably emerged as the victor, by means of a points decision, having ultimately been granted authorisation by the World Trade Organization (WTO), in October 2019, to impose \$7.5 billion of countermeasures, against the European Commission's award, a year later, of nearly \$4 billion.

Both combatants have opted to put a 15% additional duty on one another's airliners. European authorities are almost certain to follow in lock-step any further US tariff hike – but with their primary commercial aircraft manufacturers already under considerable economic pressure, a negotiated settlement would seem to be all but inevitable.

When the dispute was initiated in 2004, US president George W Bush was in power. But it persisted through the Democrat administration of Barack Obama and outlasted the Republican term of Donald Trump – on whose watch the case turned from a legal argument into one with financial consequences.

920

Unfilled orders for Airbus jets set for delivery to US customers

Delays to the WTO's consideration of the European case meant its judgement and clearance to impose penalties on imported US aircraft more or less coincided with Trump's defeat to Joe Biden in the presidential election.

Biden might be less impulsive, but no-one should expect much concession from his administration. Neither Ron Kirk nor Michael Froman, who each served as US trade representative under Obama, adopted less than a bellicose stance on the matter. Kirk had spoken of there being "simply no justification" for Airbus subsidies, while Froman had previously stated that the US side would "not tolerate" its rival's "ignoring the rules".

But whomever Biden selects to succeed Trump's pick Robert Lighthizer, they will face a different scenario from previous trade representatives, one which will demand a willingness to negotiate if the two sides are to avoid a drawn-out arms race of tariffs and counter-tariffs and establish a mutually-acceptable framework for fair competition.

While the US side, with the upper hand, is unlikely to brush away a 16-year fight – which it started – simply to



Boeing has emerged a narrow winner at the WTO... on points

Shutterstock

demonstrate moderation after four years of turbulence, the fact that both rivals have been prepared to address the main points of contention, rescinding tax breaks and relinquishing launch aid, suggests such an agreement is within reach.

Boeing backlog data indicates there are nearly 440 unfilled orders from EU customers, excluding those in the UK, while similar Airbus data points to more than double this figure, some 920 jets, set for delivery to US operators. Each side's total includes about 80 twin-aisle aircraft.

The UK will no longer be dealing with the US government as part of the EU trading bloc and, in a demonstration of its go-it-alone approach, is set to waive tariffs on Boeing aircraft directly acquired by UK carriers. But as an indispensable part of Airbus it will still be affected by the dispute if Airbus sales suffer.

With airliner production reduced, the air transport system still mired in crisis, the long-haul market weak, and the suspension on the Boeing 737 Max only just lifted, Airbus would probably have little to lose by waiting for the Biden administration to settle into the negotiating seat – although the same might not be true for other industries affected by the dispute. ▶



Comac

Six C919 prototypes are already flying

Asia programmes

Year of the C919

Having secured relative success in the domestic market for its ARJ21 regional jet, Chinese airframer Comac will now turn its attention to its narrowbody

Alfred Chua Singapore

Despite the industry-wide upheaval caused by the coronavirus pandemic, Chinese airframer Comac broke new ground in 2020.

It scored new orders from Chinese carriers, and delivered its ARJ21 regional aircraft to the country's three largest carriers — Air China, China Eastern Airlines and China Southern Airlines.

But if 2020 was the year of the ARJ21, then 2021 could be the year of the C919 narrowbody programme.

Fresh off a high in 2020, Comac will have big expectations for the C919 programme, which it hopes will compete with the Boeing 737 and the Airbus A320 family. Already, the full test fleet of six prototypes are up and flying, and, as at the end of November, the Chinese airframer received the type inspection authorisation for the programme, paving the way for final flight testing and certification.

Time to deliver

Comac is also looking to get the C919 certified and delivered to launch customer China Eastern in 2021, in what is the clearest indication of timelines since it quietly acknowledged a shift in dates in 2019.

FlightGlobal reported in 2019 that the C919 timeline had been shifted to the right, as Comac needed two

to three years for certification and delivery. This meant that the narrowbody was likely to enter service in 2021 at the earliest, instead of 2020.

However, a looming sanction war between China and the USA could threaten to derail progress on the narrowbody programme. The tit-for-tat came about after the USA approved billions of dollars in potential arms sales to Taiwan, which China regards as its own, but is also part of a long-brewing trade war between the two superpowers.

The C919 uses Leap-1C engines made by CFM International, a joint venture between the USA's GE Aviation and France's Safran. Its communication and navigation system, meanwhile, is made via a joint venture between China Electronics Technology Avionics Company and Raytheon Technologies' subsidiary Collins Aerospace. Aviage Systems, which produces the C919's avionics, is a joint venture between General Electric and AVIC.

Tough sanctions?

A US-China aerospace breakup — where China blocks US-made passenger aircraft and related aerospace components from being sold in China — could cripple the C919 programme, creating what observers say would be a nightmare scenario.

Indeed, much as 2021 could see Comac break new ground, a new year with tough sanctions on US aerospace products could also break Comac, effectively clipping the wings of its C919 programme for a few more foreseeable years.

Still, Comac can take comfort in the fact that it is still in a cushy position, at least compared with its peers.

Mitsubishi Aircraft, its rival airframer from Japan, will enter 2021 with its flagship SpaceJet regional aircraft in an effective programme freeze. Even if economic conditions start to improve in 2021, it seems unlikely that Mitsubishi will restart the programme — at least not immediately.

The company said in late October: "We will work to review where we stand, make improvements, and assess a possible programme restart."

If 2020 was the year Asian airframers trod diverging paths, 2021 will continue to see a different trajectory for Chinese and Japanese airframers. ▶



2021

US defence budget

Europe air transport

Slidin' with Biden?

The DoD enjoyed largesse under Donald Trump. What will US air defence spending priorities be under the new president?

Garrett Reim Los Angeles

After several fat years under the administration of President Donald Trump, the US Department of Defense (DoD) budget is likely to be trimmed down under President Joe Biden. However, the difference between the two administrations is not likely to be huge.

That's because the US military's role in geopolitics - a deterrent to aggression from the illiberal forces of the world, such as China, Russia, North Korea and Iran - will more or less be the same with the Biden administration, says Mark Cancian, a senior adviser with the Center for Strategic and International Studies' International Security Program.

"They will push for a strategy that looks a lot like the end of the Obama administration," he says. "And, frankly, it looks a lot like the Trump administration; that is, focused on China and Russia, with secondary focuses on North Korea, Iran and terrorism."



Tough talking: the US military's role in geopolitics will not change

Spring of hope

Can low-cost carriers lead the region out of the crisis in the next few months? They have before – and might again

Lewis Harper London

There has been a marked shift in the European airline industry's mood since a flurry of good news on the development of Covid-19 vaccines.

Previously, there were only tentative hopes that spring 2021 would bring a degree of relief from what will be a bleak winter for Europe's operators.

But the possibility that vaccines might begin to have a genuine impact on controlling the pandemic in Europe by the end of the first quarter of 2021 has changed the narrative.

"There's reasonable optimism now that summer 2021 will get back to some degree of normality," the group chief executive of Ryanair, Michael O'Leary, said at an industry conference just after the first positive news on vaccine efficacy was announced. "We may not get back all the way to 2019, but in short haul I see no reason why we won't go back to 75-80% of 2019."

Wizz Air chief executive Jozsef Varadi said in mid-November that the low-cost carrier is aiming to be back at 100% capacity "within a few months".

With international air travel forecast to be at around only 25% of 2019 levels globally during summer 2021 season, according to IATA, such figures would put both carriers well ahead of the crowd.



crisis, rather than focusing on retirements and storage, thereby maintaining the flexibility to add capacity quickly when demand allows.

That flexibility is boosted in Ryanair's case by union agreements that have seen it avoid mass layoffs. Conversely, Wizz did make some job cuts early on in the crisis, but its record of not recognising unions means – rightly or wrongly – it can flex its workforce at short notice.

Furthermore, their lack of national affiliation in Europe's liberalised aviation market means both airlines are able to shift capacity around as demand dictates – demonstrated by Wizz opening a string of bases in the region in mid-2020 as most carriers were retrenching.

In some cases, that positions them to move into markets vacated by rivals. "Some of our competitors are contracting in a big way and leaving a market vacuum behind them – of course, we make sure that we take advantage of that," Varadi said in October.

But it is also important to note that taking advantage of pent-up demand in 2021 will not be an issue of business model alone.

In the European low-cost sphere, Norwegian is teetering on the edge of the abyss, having entered an Irish process in mid-November that gives it financial protection while it attempts to restructure.

EasyJet has been much quieter than Ryanair and Wizz on its expectations for 2021, while taking a more cautious approach to adding back capacity.

At the same time, success might be measured on different terms for the network carriers. A race to secure the first ticket sales during the recovery is really just a sprint during the marathon recovery ahead.

In terms of short-term prospects, however, the market dichotomy was perhaps best summarised by Ryanair mainline chief executive Eddie Wilson: "If you've got the money, you've got the aircraft, you've got the people, you've got the space at the airports, then you are in a much better position than those [airlines] that are scrambling around, that are running out of cash, have to raise their money, looking for short-term deals all the time, selling their aircraft, firing their people."

\$30bn

Possible cut to the US military budget by the end of the Biden administration's first four-year term

That strategy requires a massive global force. "If you want to have a presence in the western Pacific, if you want to challenge Russia in Eastern Europe, and if you want to keep going after global terrorism – for all of that, you have to have large forces, they have to be forward-deployed, and all that is expensive," says Cancian.

Moreover, Biden waved off the idea of large cuts to the US military in a September *Stars and Stripes* interview, and the progressive wing of the Democratic

party fared poorly in the 2020 elections. With the Republican party likely to remain in control of the US Senate, large defence cuts look even more unlikely.

That's not to say there won't be some trimming. The Democratic party won the majority of seats in the House of Representatives and won the White House. That gives Biden the leverage to carry out some downsizing.

Cancian says he believes at the end of the Biden administration's first four-year term the budget might be down by around \$30 billion, or roughly 5% of its current level. The Trump administration requested about \$586 billion in funds for the DoD and Department of Energy for fiscal year 2020. The White House requested another \$164 billion for Overseas Contingency Operations.

Because the Pentagon is already operating in FY2021, cuts probably wouldn't come until FY2022 and FY2023, says Cancian. When spending cuts start to roll out, they are likely to affect the size of each military branch, with the US Army to be hit hardest.



2021

“A lot of strategists are looking to cut the army in general,” says Cancian. “If the priority is China and Russia – particularly China – the army has an important role, but clearly a lesser role compared with the navy and the air force.”

That likely means fewer soldiers, but also US Army aviation programmes such as Future Vertical Lift will be delayed. Instead, US Army priorities are to be long-range precision strike and air defence, says Cancian.

Recently, the US Army has been making the case that new automated flight controls should allow its Future Vertical Lift aircraft to avoid detection by hiding in the radar shadows of mountains and hills – a stealthy ability it plans to use for suppression of enemy air defence missions.

Time to retire

That might work amid the hills and valleys of Eastern Europe against Russia, but in a hypothetical fight against China in the wide-open Western Pacific it doesn't make as much sense. “Nap-of-the-earth doesn't really help you very much [in the open ocean],” says Cancian. “And, the distances are too long.”

Moreover, Cold War-era aircraft within all branches are likely to be targeted for early retirement. Even updated versions of those aircraft, such as the Boeing F/A-18E/F Super Hornet and F-15EX, are likely to be in the line of fire, says Cancian.

Some older aircraft may survive simply because there is no way to replace them quickly. For example, despite the US Air Force's (USAF's) plans to eliminate production of the General Atomics Aeronautical



Systems MQ-9 unmanned air vehicle (UAV) from its budget, Congress appears poised to add it back into its spending plans. Unless the USAF has already developed a secret replacement for many of the MQ-9's armed reconnaissance missions, it is unlikely to disappear soon, says Cancian.

Moreover, Special Operations Command's Armed Overwatch experiment, which aims to use light attack aircraft such as the Textron Aviation Beechcraft AT-6 Wolverine and Sierra Nevada/Embraer A-29 Super

Asia defence

Searching for China's cracks

Details of its military aviation programmes are hard to source, but Beijing watchers will be looking for certain signals about capabilities and ambitions

Greg Waldron Singapore

The development of Chinese airpower will continue to be a major defence theme in 2021, as observers look for enhancements of existing types and the possible emergence of a new stealth bomber.

2020 proved to be another exciting year for Chinese military aviation, with advances seen in key combat

and support aircraft programmes. Arguably the biggest news came in October, when footage emerged of a Xian H-6N bomber carrying a long-rumoured ballistic missile along its centreline.

Details about Chinese programmes are notoriously difficult to come by, fuelled mainly by dubious images and cryptic remarks that emerge in China's tightly-controlled social media space. Official channels, such as China's nationalistic *Global Times* newspaper, often post reports about Chinese military aviation, but their credibility is open to question. Beijing holds its cards close to its chest.

Nonetheless, observers will be looking for several things in 2021. Engines, the perennial bugbear of Chinese aircraft, will be one focus.

Local power

China's premier fighter, the Chengdu J-20, is flying with a local engine, the Shenyang WS-10 Taihang – early versions used Russian Saturn AL-31s. In November 2020, images emerged of J-20s powered with an updated version of the WS-10, the WS-10C.

The J-20's ultimate powerplant, however, is the Xian Aero Engine WS-15 Emei. Estimates suggest that the WS-15's maximum thrust will be 18.4t (180kN), potentially giving the twin-engined J-20 genuine “fifth generation” performance, including supercruise – the ability to travel at supersonic speeds without engaging the afterburners. There are also persistent rumours about a two-seat version of the J-20.

In late 2020 rumours emerged that the Y-20



The F-35 programme might slow down slightly under Biden

US Air Force

Tucano to carry out close air support missions may be viewed favourably as a cost-saving measure that also preserves flight time on the Lockheed Martin F-35's airframe.

"[The USAF] recognises that every sortie flown by an F-35 against insurgents is that many flight hours that they have lost on the F-35 [airframe]," says Cancian. "These things do not have infinite lifespans."

When it comes to production of the F-35, cutbacks are unlikely to be deep. "They are not going to

convince the services or Congress to cut back substantially on the F-35," says Cancian. "They might keep it capped at 40 [units] a year for the air force."

Other winners are likely to be long-range strike weapons such as hypersonic missiles, and bombers like the Boeing B-52 and Northrop Grumman B-21 Raider. The range of those systems would allow the USAF to reach across the Pacific Ocean to targets within China.

Going ballistic?

One long-range weapon system that might be subject to delays is the USAF's Ground Based Strategic Deterrent (GBSD), a replacement for the ageing LGM-30 Minuteman III intercontinental ballistic missile system. Democrats have voiced opposition to modernising the USA's nuclear arsenal.

However, eliminating a leg of the country's triad strategy – the ability to launch nuclear weapons from ground missile silos, submarines or aircraft – is unlikely. Cancian says instead Biden and House Democrats might slow-fund the GBSD, rather than outright eliminate it.

Ultimately, coming defence budgets will increasingly focus on unmanned systems, says Cancian. That might spark a debate on the nature of the Next Generation Air Dominance (NGAD) programme, the USAF's eventual replacement for the Lockheed F-22 Raptor. The service has described NGAD as manned. However, there will likely be those that see UAVs as the future of aerial combat and push for it to be unmanned, in order to save costs, increase its capabilities and have an aircraft that could be more expendable in combat, says Cancian. ▶



An October 2020 video appears to show an H-6N carrying an air-launched ballistic missile

Chinese social media

strategic transport, heretofore powered by Soloviev D-30KP-2s, had operated a maiden flight with the new Shenyang WS-20, a more efficient engine featuring a higher bypass ratio. Should a WS-20-powered Y-20 break cover in 2021, it will mark a milestone both for the programme and for China's broader engine efforts.

Moreover, the coming year could bring more information about the Y-20's other role as an air-to-air refuelling tanker. With just a handful of older H-6s and a trio of Ilyushin Il-78s earmarked as tankers, air-to-air refuelling is a weak area for the People's Liberation Army Air Force (PLAAF), particularly as it looks to project power further from China's shores. A high capacity, indigenous tanker in the form of the Y-20 would go some way to rectifying this weakness.

2021 might offer more clarity around China's other stealth fighter, the AVIC FC-31. Testing has continued with the type, an updated version of the J-31 that appeared in 2014's Zhuhai air show. It is understood that the PLAAF is not interested in the FC-31, but that the People's Liberation Army Navy may want it as a new carrier-borne fighter to replace its problematic Shenyang J-15.

Strategic capability

One potentially big story for 2021 relates to China's developmental stealth bomber, the H-20. It is understood that the H-20 will resemble the Northrop Grumman B-2, and provide Beijing with a true strategic bomber capability. Pictures of the new type are greatly anticipated, although some observers believe that China might have difficulty incorporating a sufficiently powerful powerplant.

As China's most numerous bomber, the H-6 will continue to be a source of major interest, particularly its most advanced variant, the H-6N. In addition to the H-6N's ability to carry a ballistic missile, it is also believed capable of carrying an unmanned air vehicle (UAV).

Finally, UAVs will continue to be a major focus. China has developed UAVs for a broad range of missions, from reconnaissance to cargo carriage. Like the west, is it also looking at the future of air combat, developing unmanned combat air vehicles such as the Dark Sword and Sharp Sword. Tantalising hints about both programmes might – or might not – emerge during 2021. ▶



2021



BAE Systems

Tempest partners include BAE Systems, Leonardo UK, MBDA UK and Rolls-Royce

Europe defence

Out of formation

The two European groups working on separate proposals for the next generation of fighter aircraft are not likely to be joining forces any time soon

Craig Hoyle London

One certainty for 2021 is that Europe's parallel efforts to develop the region's next-generation Future Combat Air System (FCAS) will not see a convergence.

Indeed, the rival activities – which respectively involve the defence ministries and industrial champions of France, Germany and Spain; and Italy, Sweden and the UK – will make significant progress along their separate tracks.

Paris, Berlin and Madrid are participating in an FCAS programme including the design of a New Generation Fighter, with Dassault and Airbus Defence & Space at the forefront.

After formally launching the project at the Paris air show in June 2019, France and Germany in February 2020 started an 18-month Phase 1A risk-reduction activity. This should be followed from around 2026 by the first flights involving demonstrator platforms. The aim is for the initiative to deliver an operational successor for the nations' Eurofighter and Dassault Rafale fleets from 2040.

Other major participants include propulsion system partners MTU and Safran, avionics and sensor specialists Hensoldt and Thales, and Spain's Indra.

Tempest outline

"Despite corona[virus], FCAS is on time and we are making good progress in Demo [Phase] 1A and JCS [the Joint Concept Study]," Airbus Defence & Space chief executive Dirk Hoke said during a Paris Air Forum online conference session on 20 November.

Meanwhile, the UK's Team Tempest industry group – comprising BAE Systems, Leonardo UK, MBDA UK and Rolls-Royce – has delivered the contents of its outline business case proposal to the UK Ministry of Defence. This caps their work performed since the Tempest activity and a full-scale mock-up of a future manned fighter was revealed at the Farnborough air show in July 2018.

In an encouraging sign, the UK government on 19 November announced a £24.1 billion (\$32.1 billion) uplift in defence spending for the next four years. Representing an overall 0.5% budget increase for the sector, the sum includes a £1.5 billion allocation for research and development on projects including FCAS, artificial intelligence and cyber technologies.

Exhibitions

Shows on the road

The industry expo was replaced in 2020 by the virtual convention. It will now likely be the second half of 2021 before the calendar as we knew it resumes

Murdo Morrison London

If you think aviation had a rough 2020, consider the conference and exhibitions industry. A sector based entirely on face-to-face gatherings and social networking was shuttered in March around the world and, with rare exceptions, remained so for the rest of the year. From the beleaguered exhibition organisers themselves to the ranks of workers who transport, construct and disassemble these instant communities, and the hotels and restaurants that depend on travelling, free-spending delegates, the effect on jobs and local economies has been catastrophic.

So too on the industries for whom the convention calendar is the schedule around which many companies plan their marketing activities – including aerospace. When the Singapore air show took place in early February 2020, Covid-19 was already spreading from China into parts of Southeast Asia and beyond. The show went on – albeit with depleted exhibitor and visitor numbers – but others did not. Starting with the annual Aircraft Interiors Expo (AIX) in Hamburg in late March, every significant event since was postponed or cancelled, including July's Farnborough air show, and now Paris in June 2021.

With cases still rising in many parts of the world, and before news broke about promising vaccine developments, concerned organisers had already

begun moving shows scheduled for the first half of 2021, with AIX shifting to September and Australia's Avalon now taking place at the end of the year, rather than February. The EBACE business aviation convention in May also looks vulnerable and GIFAS, the French trade association behind the world's biggest air show, announced that Paris was being cancelled outright, with the next iteration not taking place until June 2023.

Virtual reality?

A very 2020 phenomenon emerged – the virtual air show or convention. Farnborough and the National Business Aviation Association were among those in the aerospace sector to pioneer digital events comprising webinars and opportunities to visit “exhibitors”. For many professionals largely confined to home offices and unable to travel, they proved a welcome diversion. Few would suggest, however, that they are anything but a poor substitute for the real thing. Even high-tech companies such as Apple prefer the drama and buzz of launching products at face-to-face events.

Whether we spend most of 2021 continuing to network with our peers over Zoom, or return to shaking hands in a meeting room and looking customers in the eye, “kicking the tyres” of new technology on the exhibition floor, and relaxing with industry colleagues over a beer or coffee hangs on the availability and effectiveness of vaccines, aided by the onset of rapid testing.

Few in a global industry relish the prospect of a new normal based on tele-conferences. However, with few signs of the virus in retreat at the end of 2020, it is difficult to see a change to the status quo before mid-year at the earliest. ▶



£24bn

Increase in UK defence spending in next four years

In addition to the Team Tempest partners, more than 200 other UK companies and academic institutions had received contracts linked to the activity by October 2020. Michael Christie, BAE's director of FCAS, refers to a “Tempest Generation” effect, where more young people are being attracted to work in the aerospace sector because of the project.

Further clarity on the UK's long-term commitment to Tempest is expected to emerge when it publishes the outcome of its integrated review process early in the year, while Sweden was scheduled to detail its future priorities in a new defence bill in December 2020.

The early-stage nature of both FCAS projects effectively rules out the likelihood of their combination, as do factors including national industrial considerations and the complications of the UK's Brexit process. Despite the potential extra cost and reduced sales volume implications of having two future European fighter efforts, it is hard to see viable long-term prospects for some of its current defence industry players, were the projects to be rationalised.

Additionally, with both FCAS concepts calling for a system of systems approach, with fighters, a sophisticated new class of guided weapons and



2021

accompanying unmanned assets – described as remote carrier, or additive capability vehicles – the initiatives offer more industrial flexibility than was possible with previous projects.

While both FCAS initiatives offer hope for Europe's fighter industry and military capability, questions had been raised as to whether Airbus, BAE, Dassault, Leonardo and Saab could keep their facilities active until large-scale production of new systems can occur.

But here too the signs are encouraging. Industrial continuity on the Eurofighter programme has been assured by Germany's follow-on Quadriga buy of 38 Tranche 4 examples. With production currently running for export buyers Kuwait and Qatar, Berlin's order will production running until 2030. Spain, meanwhile, could also acquire a further batch of 20 to replace some of its Boeing F-18s.

60

Minimum number of Gripen E fighters to be produced for Swedish air force by Saab

Dassault also has a strong Rafale production backlog for France, India and Qatar, and Greece recently announced its interest in buying 18 of the type.

Saab, meanwhile, which is at the start of producing 60 Gripen Es for Sweden and 36 E/Fs for Brazil, is pitching the fighter and its earlier C/D-version to other potential buyers.

While the manufacturers of Europe's current three rival fighters will increasingly be positioning for key roles aboard a future class of combat aircraft, more immediate opportunities exist to further safeguard their current production activities.

The Eurofighter and Rafale are both in contention for Switzerland's potentially 40-unit new fighter aircraft need, facing competition from the F/A-18E/F Super Hornet and Lockheed Martin F-35A. Bern expects to announce its decision during the second quarter.

Finland's HX contest will also reach a conclusion in 2021. Helsinki is assessing the same candidates as Switzerland, plus the Gripen E/F. ▶

V. Almanns/Dassault



The New Generation Fighter is a joint effort being pursued by France, Germany and Spain



Latin America air transport

Southern discomfort

Carriers in Latin America will not have an easy recovery from a pandemic that has seen three of the region's major airlines enter bankruptcy protection

Pilar Wolfsteller Las Vegas

Latin American airlines' climb out of the coronavirus-driven downturn will likely be bumpier than their peers' on other continents. Economic instability coupled with widely divergent travel restrictions, newly imposed taxes and a lack of government financial aid will make for an uneven recovery.

While some countries in the region, such as Argentina and Panama, sealed their borders and ceased flights to mitigate the spread of the virus, others, such as Brazil and Mexico, still allow flights, if at reduced levels.

In addition, three of the region's major carriers – Aeromexico, Colombia's Avianca and Chile's LATAM Airlines – are now restructuring under US Chapter 11 bankruptcy proceedings, creating additional uncertainty for customers and investors.

These three have secured financing and hope to emerge from the restructuring process in the coming



Azul's variety of aircraft sizes helps it respond to shifts in demand

months in a stronger, more-stable position. And recent news about successful vaccine testing programmes has also buoyed the mood, creating some optimism.

"Once the vaccine proves effective and once countries begin to recover their economic situation, growth will be very fast," says Eliseo Llamazares, head of the Latin American aviation and tourism practice at KPMG. "Obviously in this context of uncertainty it is more important to be prudent than optimistic. For this reason, people think that the recovery will be slow.

"But I prefer to be optimistic," he adds.

Brazil, the most populous country in Latin America, maintained a skeleton network of air connectivity throughout the crisis. Going into the southern hemisphere's summer travel season, which extends through Carnival in February, leading airlines Azul and Gol say both leisure and corporate customers are returning in greater numbers.

Brazil is considered one of the most underserved markets, with lower per-capita air travel trips than in neighbouring countries. But with a growing middle class that can afford to travel by air, and vast distances to overcome, Brazil's passenger carriers have grown quickly, and expect that growth to continue.

"Touristic activity in the country was always high throughout the pandemic," Llamazares says. "People lived with Covid and knew what the risks were."

More leisure

Gol said in November that it had "recovered 100% of pre-Covid demand", predicting that by the end of the first quarter of 2021 it will resume flights to all pre-coronavirus destinations.

Azul, meantime, is even more bullish, saying it expects domestic leisure passenger revenue in the coming months to exceed last year's figures.

"The airline with the best performance during the pandemic was Azul," Llamazares says, adding that the carrier's flexibility and variety of aircraft sizes – from ATR 72 turboprops to Airbus A330s – help it respond to demand fluctuations.

Both Azul and Gol have said that in addition to Brazilians looking for a vacation break in their own country, more lucrative corporate customers are coming back faster than, for example, in North America.

Azul expects 35-40% of business travel will return by the end of 2020, rising to 75-80% by July.

Llamazares says it is a cultural thing. "In Latin America, you have to close a deal in person. Face-to-face contact is more important here, to build up trust. We need to travel to do business."

Still, concern about the economic health of Latin American countries could lead companies to cut travel budgets, slowing a business-travel rebound, he says.

Copa Airlines had the rug pulled out from under its business model – connecting out-of-the-way secondary cities to the capitals of the hemisphere – when its home country, Panama, imposed a five-month lockdown. The government banned travel through Tocumen International airport, which Copa has long marketed as its "hub of the Americas".

But Copa and Tocumen could be unexpected winners from the crisis, analysts say. Owing to its advantageous geographical location directly between the North and South American continents, 80% of Tocumen's annual 13 million passengers travel through the airport on their way to somewhere else.

The airport's new second terminal, opened in 2019, is currently idle, but Llamazares says it is sitting pretty.

"In this new context of social distancing, needing more space between flights, Tocumen has a lot of capacity to grow," he says.

Low-density routes

Citigroup's director of research for airlines in the Americas, Stephen Trent, agrees. "Copa's game is to transport the guy going from Miami to Maracaibo, Venezuela, or Sao Paolo to Guatemala City. You have this preponderance of low-density routes to places which are now going to be even harder to reach because the network airlines have pulled back so much."

Copa, which launched out of the lockdown in August with eight destinations, expected to have about 40% of pre-Covid capacity up and running by the end of 2020.

The divergent pace of reopenings, vastly different health requirements in different countries and newly imposed taxes – as well as the lack of government support for aviation – have frustrated the region's industry executives and trade groups.

IATA has called upon countries to streamline policies around travel restrictions, implement more coronavirus testing and rein in fees in order to reopen air corridors and motivate customers to return to air travel.

Argentina imposed some of the strictest travel curbs on the continent, shutting down both domestic and international air traffic. In the aftermath, the country has systematically imposed barriers that will prevent a widespread recovery, the organisation maintains.

New travel taxes of up to 35% and additional levies on US dollar purchases overseas of up 60% discourage potential customers who are already wary of taking an airliner anywhere. Government restrictions on airport operations also now prevent low-cost carriers such as FlyBondi from reinstating service.

"Argentina's air travel industry is in the worst situation in the region," Llamazares says. But Argentinians have always been savvy, avid travellers, and they will demand the freedom to move around after the pandemic is over, despite the government's perceived efforts to keep them on the ground.

"Argentina always surprises us," Llamazares adds. "I think 2021 will be weak, but 2022 will be a positive surprise in Argentina." ▶



Elettronica is one of four Italian businesses backing Tempest

Murdo Morrison London

Working as part of a pan-European military aircraft enterprise is nothing new for Elettronica. The Italian electronic warfare (EW) specialist – founded in Rome 70 years ago and still family-run – has since the 1990s been the country's champion on the EuroDASS consortium that provides the Praetorian defensive aids subsystem (DASS) on the Eurofighter Typhoon. Before that, it played a role in the Panavia Tornado programme.

Now the firm is one of four Italian industrial representatives working with the UK's Team Tempest in developing a successor to the Typhoon – the Tempest future combat air system. The effort pits aerospace and defence companies in Italy, Sweden and the UK against their counterparts in France,

Germany and Spain, which are collaborating on a rival project spearheaded by Dassault and Airbus Defence & Space to design a rival next-generation fighter to go into service in the 2040s.

In global aerospace terms, Elettronica is a modest-sized firm: it employs around 750 people and its 2019 revenues of €268 million (\$326 million) place it just outside FlightGlobal's Top 100 ranking of aerospace groups by revenue. However, the company's well-honed expertise in EW means it can compete on equal terms with some of the industry's largest players, insists Paolo Izzo, vice-president global sales. "EW in these big groups is a division. It is our entire business," he says.

Joining the Italian contingent on Team Tempest alongside Elettronica are GE Aviation subsidiary Avio Aero, Leonardo, and the national arm of European missiles house MBDA. In July, the four companies

Italian electronic warfare specialist Elettronica has a long track record of involvement in European defence programmes, but has also been making its own mark in markets beyond the region

Team player



The company's new EW simulation lab is used for training

sales. "And that experience is the best base for us to help develop a sixth-generation fighter."

Other corporate characteristics necessary for the Tempest effort, he believes, include "the ability to work with partners, to follow a technological plan, and to be open and agile to adapt to new developments. These are all in the DNA of Elettronica."

Electronic warfare

Elettronica's EW expertise stretches from infrared countermeasures against heat-seeking missiles to escort-jamming technology and anti-drone systems. EW, maintains Zoccali, is becoming crucial in modern warfighting. "It is much more important than in the past. In the next-generation fighter, EW will play a crucial role in a systems of systems environment. Future battles will only be won if we can win this technological race," he says.

A relatively new development for Elettronica is its ground-based ADRIAN – anti-drone interception, acquisition and neutralisation – system, which, says Izzo, is the result of an effort "five to seven years ago to study threats and doctrine in the EW field". The result: a product able to counter hostile mini- and micro-drones, comprising command and control radar, jammer and electro-optical technology. Elettronica is in talks with the Italian military and a "country in the Middle East" about deployment.

Elettronica's business strategy includes moving from marketing single pieces of equipment to offering entire EW suites, marking an approach to airborne combat technology "in which the various subsystems are no longer federate and physically divided by type, but, rather, integrated at a functional level", according to the company. "We want to be not only a provider of products, but a solution provider," says Izzo.

An example of this is the Virgilius multi-platform EW system, which combines alert, surveillance and deception functions in a one-box design,

- with BAE Systems, Saab and other industrial representatives from the UK and Sweden - officially kicked off "trilateral industry discussions" on what each company will contribute to the development effort. This followed a framework pact signed at 2019's DSEI defence exhibition in London.

But that was not the only international collaboration initiated by Elettronica that year. It also joined its EuroDASS partners Leonardo UK, Spain's Indra and Hensoldt of Germany to launch "Praetorian Evolution" - a "future concept" for the DASS that provides protection for the Typhoon from the likes of infrared or radar-guided missiles. Future capabilities are likely to include high-precision targeting and advanced combat identification.

"We have been the design authority on the Praetorian with Leonardo UK since the beginning," says Giovanni Zoccali, vice-president Europe and consortia

Light aircraft

Versatile Traveller

With two new versions of its P2012 on the cards and deliveries of its flagship regional transport to Cape Air under way, Tecnam has barely drawn breath in 2020

Murdo Morrison London

Despite the economic and logistical challenges of Covid-19, 2020 was a busy year for Tecnam, the Campania-based light aircraft manufacturer and the first new entrant in the commercial air transport market in a generation with the nine-passenger P2012 Traveller, assembled at its site near Naples.

After putting its first P2012 into revenue service just before the pandemic took hold on 22 February, launch customer Massachusetts-based Cape Air had taken delivery of 16 of the Lycoming TEO-540-C1A-powered twin-piston type by November, with three more set to arrive before the end of the year. The airline has a total firm order for 23, and options for another 90.

Cape Air says the P2012, which replaces some of the carrier's legacy Cessna 402s, has been "well received by our passengers and the communities it serves". The P2012s delivered so far are flying in New England, where the Cape Cod-headquartered firm serves a range of airports, including Boston, but the regional carrier also has operations in Montana and the Caribbean.

Additionally, in October, Tecnam announced a partnership with Rolls-Royce to develop an electric-powered version of its largest aircraft, called the P-Volt. The two companies have already paired on a project called H3PS to design an electric version of Tecnam's four-seat P2010, pairing a R-R electric motor with a Rotax combustion engine.

» and can be integrated with a directional infrared countermeasures device. "It is a passive and active system in one," says Izzo. Customers include the Italian air force, which has fitted Vigilius on its Leonardo Helicopters AW101 combat search and rescue fleet.

Overseas success

Elettronica says it has grown its order backlog by more than 50% in five years to around €800 million, mainly as a result of success overseas, particularly in the Gulf and Asia. The company has recently opened sales and support offices in Abu Dhabi, India, Qatar and Singapore, and "this intense activity is bearing fruit with substantial orders".

To support its customers Elettronica has also opened a simulation lab at its headquarters near Rome. Zoccali expects that in the next 10 years, the

That is not the only new variant of the P2012 unveiled in 2020. A month earlier, Tecnam rolled out its Sentinel SMP, a special mission variant of the platform on which it has worked with L3Harris, capable of accommodating five mission specialists along with one or two pilots, as well as a turret-mounted camera and synthetic aperture radar.

Tecnam says a fully-equipped Sentinel SMP with six crew members on board will, at a maximum take-off weight of 3,680kg (8,110lb), provide up to nine hours' flight time, at "a fraction of the acquisition and operating costs" of other types performing a similar role. The company says it "foresees an increasing demand" from the special mission market.

Also in October, Tecnam secured European Union Aviation Safety Agency certification for the latest iteration of its P2010 piston single, the diesel/Jet A1-powered P2010 TDI, five months after rolling out the variant at its Capua base. The 170hp (127kW) Continental CD-170-powered TDI joins existing avgas-powered 180hp and 215hp versions.

However, the P2012 remains its flagship. Tecnam believes the type, which has a list price of \$2.6 million and range of 950nm (1,760km), has the potential to be a genuine disruptor in the small regional transport market, with its only rivals being airframes that were designed 50 or more years ago, such as the Cessna 402 and the Britten-Norman Islander, hundreds of which remain in operation.



Cape Air introduced its first P2012 to service in early 2020

Cape Air

company will be making just over half its revenues from outside Europe.

Like many of the country's businesses, Elettronica is proud of its "made in Italy" credentials. "Traditionally, we are an Italian company and the EW point of reference for the Italian ministry of defence," says Zoccali. Italy provides a "solid 10%" of revenues, but that domestic endorsement is vital. "Support from your own armed forces is an important step for sponsorship of sales to all the markets in the world," he adds.

Even cracking the relatively closed transatlantic marketplace may be a possibility in the future, if Elettronica's bosses can find the right company to work with. "We do not at the moment compete for the US budget," says Zoccali. "But what we are trying to do is partner to present our portfolio. You never know, one day we may have a presence there."

Avio Aero

A GE Aviation Business

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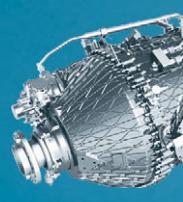
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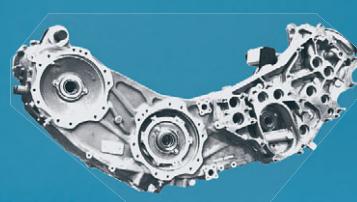
ADDITIVE
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SAND
CASTING

Rocketing ambitions

Thales Alenia Space



Avio is prime contractor for Europe's Vega launcher

Murdo Morrison London

I taly's 60-year-old space sector suffered a setback on 15 November, when an Arianespace Vega launcher, built by the country's rocket propulsion champion Avio, veered off course 8min after launch from the Kourou spaceport in French Guiana and plunged into the Atlantic along with its payload of two satellites. It was the second mission failure of a Vega rocket in 18 months.

An inquiry into the failure of mission VV17, led by the European Space Agency (ESA) and operator Arianespace, was underway at time of writing, with evidence pointing to an integration problem during assembly of the electro-mechanical actuator system on the nozzle of the launcher's fourth and final stage, causing the rocket's trajectory to degrade just after the stage had ignited.

Following the incident, Giulio Ranzo, chief executive of Avio, offered via a video message "deepest apologies" to customers – the SEOSAT-Ingenio and

Taranis satellites had been on board. He vowed to "restore the viability" of the 30m (98ft)-high launcher, which can carry payloads up to 1.5t. "We can fix this quite rapidly," he insisted.

Getting the launcher – 65% of which is manufactured in Italy – back to service quickly will be vital not just for Avio but the reputation of the country's space industry, one of Europe's biggest, with a history dating from Telespazio's founding in 1961. The latest version of Europe's small launch vehicle, Vega C, which is able to take 2,300kg (5,070lb) to low Earth orbit, had been due to fly in June 2021.

Space entities

The Rome region-headquartered space propulsion house – formerly a sister unit of military and commercial engine systems manufacturer Avio Aero, but spun off as an independent business when the latter was acquired by General Electric in 2013 – is one of three major space entities based in or with a substantial industrial presence in Italy.

An early cosmic pioneer, Italy is determined to continue playing a central role in emerging fields such as reusable space transportation

The others are satellite services specialist Telespazio, owned two-thirds by Leonardo and one third by Thales, and satellite manufacturer Thales Alenia Space, another joint venture between the Italian and French companies in which the shareholdings are reversed. The two businesses market themselves jointly as the Space Alliance.

However, Italy's space sector also comprises some 200 start-ups and other small and medium-sized firms that are "a driver for the economy and an important seed of growth, delivering a quantitative and qualitative return", says Giorgio Saccoccia, president of the Italian Space Agency (ASI). In total the industry employs more than 7,000 people and turns over around €2 billion (\$2.4 billion).

Italy was a European cosmic pioneer – it became the third nation to put a satellite in space after the USSR and the USA with the launch of atmospheric research platform San Marco I on a US rocket in 1964. Throughout the 1960s, Telespazio played a key role in satellite broadcasting, including distributing images of the Apollo 11 Moon landing across Europe.

The ASI, which with a budget of around €800 million is one of the largest space agencies in Europe, has also been heavily involved in the International Space Station (ISS), sending three Italian astronauts on a total of 10 missions. Thales Alenia Space has been the second largest industrial participant in the construction of the ISS itself, producing many of the housing modules on behalf of ESA.



Italian astronaut Luca Parmitano on the International Space Station

"Our long term strategy with the ISS has been to place us in a strong position in terms of space exploration," says Saccoccia. "We have done this via our participation in ESA, but also through direct collaboration with the USA, and as a result of this we have been responsible for many elements of the ISS. This has given us an opportunity to have access with [Italian] astronauts."

Telespazio chief executive Luigi Pasquali believes Italy can continue to play a major role in space because "our industrial sector covers the entire value chain", making it a leader in fields such as synthetic aperture radar, situational awareness and collision avoidance systems, and space-based military communications; the company is behind Italy's SICRAL secure satellite system.

A healthy supply chain of SMEs that can draw on venture capital as well as state funding will remain crucial to the industry, he maintains. "The space economy has brought space closer to users, broadening its previously technological horizon," he says. "Today space is user-driven by the needs of the market. The new paradigm justifies private funding as it ensures a return on investment."

Launch pad

As well as getting the current Vega programme back on schedule, future key projects for Italy's space sector include a further iteration of the launcher, the Vega E, whose maiden flight is scheduled for 2024. On 9 December, Thales Alenia Space and Avio also announced a contract with ESA to develop Europe's automated reusable Space Rider transport system.

The platform, which will be launched on Vega C, is designed to remain in low Earth orbit for two months before re-entering the atmosphere and landing. Space Rider will build on the Italian-led IXV project, the experimental European space shuttle that flew in 2015, with Thales Alenia Space being responsible for the re-entry module, and Avio the propulsion system and service module.

Avio's Ranzo says Space Rider expands the use of the Vega launcher into returnable transport and in-orbit servicing. Massimo Claudio Comparini, senior executive vice-president at Thales Alenia Space, believes the effort, led from the joint venture's Turin site, puts Italy "at the forefront of the space economy and will boost the huge development opportunities offered by the space domain".

November's Vega failure may have slowed the trajectory of its space industry in the short term, but with its central role in initiatives such as Space Rider, Italy is determined to remain one of Europe's – and the world's – great space nations in the decades to come. ▶

The Italian Space Agency

For over 32 years Italy has been looking at space through the eyes of the Italian Space Agency (ASI).

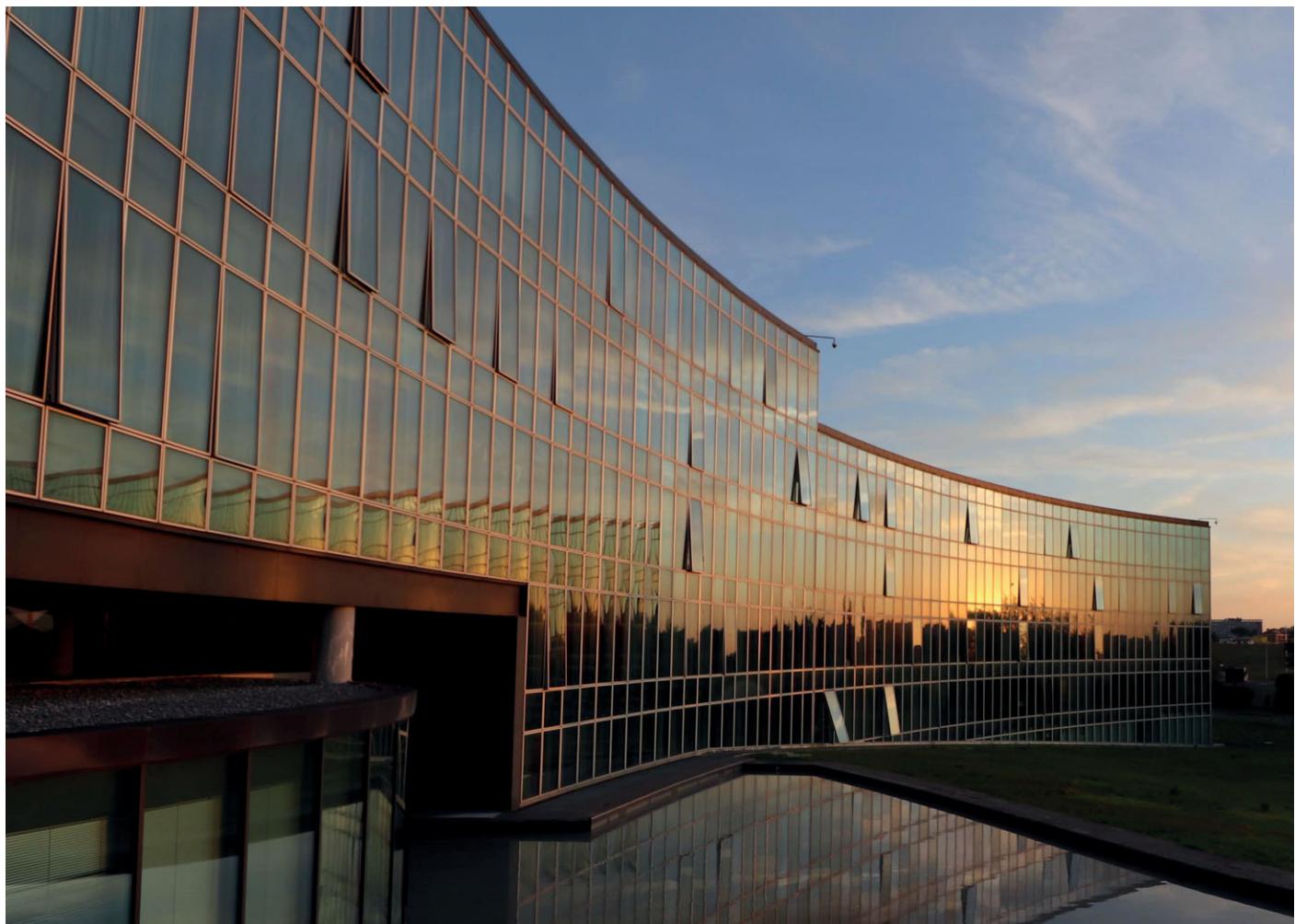
ASI has the task of preparing and implementing the Italian space policy both for national and international programs in accordance with the Government's directives set by the "Interministerial Committee for Space and Aerospace Policies" (COMINT)

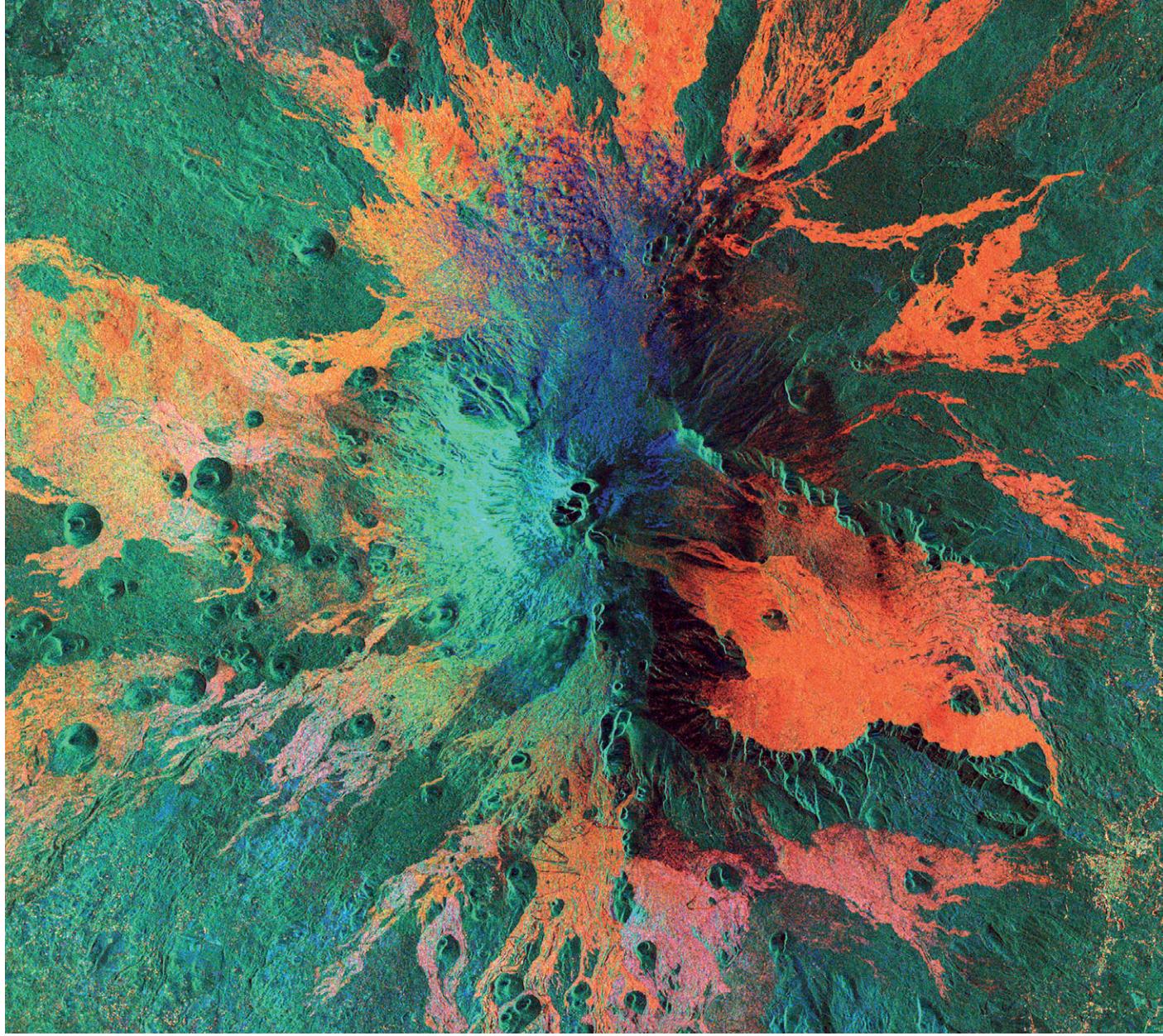
that reports directly to the President of Council of Ministers.

ASI is today among the top six space agencies in the world and Italy is the third contributing country within the European Space Agency (ESA) after France and Germany. Thanks to its diplomatic capacity, ASI boasts international collaborations with all the major space agencies of the world: first of all, with NASA, which has led ASI to take part in some of the most interesting scientific missions.



Agenzia Spaziale Italiana





The Earth from Space under the Italian lens

Thanks to the experience in building satellites and in radar technology in the field of Earth Observation, Italy with the Italian Space Agency is at the forefront in protecting and monitoring our planet.

Climate change monitoring, emergency management, environmental surveillance. These are just some of the potential applications of the Italian technological excellence that in thirteen years has changed the way we observe the Earth. We are talking about the COSMO-SkyMed dual constellation – civil and military - developed by the Italian Space Agency (ASI) in collaboration with the Ministry of Defense.

Together with the European Earth observation program Copernicus, COSMO-SkyMed boasts a number of features that can be exploited in different domains, including archaeological monitoring and the preservation of the world cultural heritage.

In detail, the First and Second generation satellites of this constellation are able to scan our planet from space meter by meter, day and night, regardless of weather conditions. The innovative characteristics of the radar satellites of COSMO-SkyMed and COSMO-SecondGeneration represent the different nature of the land observed with false color images - thus discriminating water, trees, crops, glaciers, ground covered with snow, etc. Thanks to a very high spatial resolution and to the power of the signal they can also provide a detai-

led representation of urban or industrial environments, extracting information not only from reflective surfaces, but even from shadows. The satellite system can be used in various applications: from security and surveillance of territories and boundaries, to the prevention and analysis of natural disasters.

This constellation is the result of the collaboration between industry and Italian research which, led by ASI, has created a unique product in the world, able to further strengthen the Italian world leadership in the sector of Earth observation.

There are a total of five satellites currently in orbit. The fifth, that represents the first satellite of the new generation, was added over a year ago and the second satellite is waiting to be launched later this year.



Blackshape

Company's two seat, ultralight Prime was certificated in 2012

Murdo Morrison London

A decade after its birth, and despite a very fragile market for flying schools and commercial pilot recruitment, Italy's Blackshape is preparing for an ambitious ramp-up of its flagship piston trainer programme. After launching the BK-160 Gabriel as its second product in 2015, the company is looking to boost annual production of the tandem-seat, all-carbon type to 30 units in 2021, and up to 60 by 2023. Since the aircraft's certification in 2017, around 20 examples have entered service.

It is a "challenging" target, admits chief executive Luciano Belviso, an aerospace engineer who founded the business – based in the southern Adriatic port of Monopoli – in 2010. However, he is confident that a reviving commercial aviation training sector in 2021, together with emerging interest from "light ISR [intelligence, surveillance and reconnaissance]" and high-end recreational customers, justifies his optimism. "Our backlog is exceeding our aspirations," he maintains.

Blackshape's original product was the Prime, a low-wing, two-seat ultralight, powered by the 75kW (100hp) Rotax 912 or the larger 86kW Rotax 914, and certificated in 2012. The company has sold some 80 examples, mostly to private pilots. However, shortly after its release, Belviso says he and his team identified a "big potential from the B2B [business-to-business] market" based on "feedback from the performance of the Prime", and started talking to training organisations about a higher-spec offering for that sector.

The result was the Lycoming IO-320-powered Gabriel, work on which began in 2015 with certification following two years later, just before the aircraft's unveiling at the Aero show in Friedrichshafen, Germany. The 9m (29ft 5in)-wingspan aircraft has

retractable landing gear, a Hartzell Raptor three-bladed propeller, and an Aspen Avionics Evolution 1000 glass cockpit. It is capable of a maximum level speed of 164kt (304km/h).

Customers include KLM low-cost subsidiary Transavia, which in 2019 launched its multi-crew pilot licence syllabus with the Zelf Vliegen flight academy in the Netherlands. The school uses two Gabriels to train students in basic flight training, including upset prevention and recovery, and has plans to add further aircraft "after the pandemic", says Belviso. The Gabriel's maximum take-off weight is 850kg (1,870lb) and no other type in its category is purpose-built for pilot instruction, says Belviso: "It is the first plane designed for training for several decades."

Angel investment

Blackshape has a 100-strong workforce, but since 2011 has been part of industrial holding group Angel, whose companies in sectors such as railway signalling and automatic payment systems employ more than 1,600, including 1,200 engineers. While Blackshape remains largely autonomous, Belviso says Angel's involvement is more than a distant financial investment. "There is a lot of mentoring involved and we can draw on the resources and competences of a larger entity," he says.

Blackshape addresses three segments: recreational, a "growing training market, and another growing portion, which is light ISR", says Belviso. For the latter, the firm has developed a version of the Prime called the BK-ISR, able to carry up to 200kg of electro-optical sensor payloads. In 2019, a remotely-piloted example took part in an Italian navy-led surveillance demonstration in the Gulf of Taranto to the south of Italy, as part of the European Defence Agency's OCEAN 2020 programme. An ISR variant of the Gabriel, with a higher payload, is also available.

Italian aircraft developer has set itself a ‘challenging target’ for output of its flagship programme in 2021, with high hopes for sales in the ISR and US recreational markets

Blackshaping the future

Belviso says Blackshape does have undisclosed ISR customers, and he believes there are still plenty of opportunities. “The market tends to be large platforms with very high performance sensors. If we shift below that, it is possible to answer a large number of tactical missions, such as maritime surveillance, where you don’t need a large platform, or a rotary solution, which is more expensive,” he says. “Scenarios have changed a lot in 20 years.”

Belviso expects the defence and parapublic sectors will take longer to crack because of the “slower decision-making process”, and that commercial training will remain Blackshape’s biggest sector for the next few years. “Despite the pandemic, we expect this market to stay consistent,” he says. Customers include the Test Flying Academy of South Africa, which specialises in the training of commercial and military

test pilots and flight-test engineers, and operates four Primes, with three Gabriels due to be added.

One possible development for Blackshape is a turboprop version of the Gabriel. In July, the company said it had conducted several flights of a Rolls-Royce M250-B17-powered “Gabriel-TP”. Belviso is reluctant to give further details, promising only that “we have a target in mind [for this project] and sometime in 2021 we will provide an update”.

Also on the cards is a plan to open a new factory at Bari airport, most likely towards the end of 2021, to help with the production increase.

Order pipeline

Additionally, Blackshape is stepping up its marketing efforts in the USA, where light sport aircraft regulations make the Prime uncompetitive in the general aviation segment, but there is a big opportunity with the Gabriel, says Belviso. Its first aircraft there was used for US Federal Aviation Administration validation. The pandemic has delayed further deliveries, but Belviso says there is “a full pipeline” of orders, and shipments to the USA will start in the second quarter of 2021.

Describing the Italian-styled type as a “Ferrari of the skies”, he depicts the typical US GA customer as “someone who enjoys the pleasure of flying rather than just needing an aircraft to get from A to B”.

It is a philosophy that also applies to its approach to the training segment. The difference between Blackshape and many of its rivals is that “we never intended to make a solution that competes only on price”, says Belviso, who started the company with co-founder Angelo Petrosillo because the pair wanted to “go back to our origins” in southern Italy after working abroad. “We are dedicated to a niche of the market that wants dedicated solutions and whose priority is to build airmanship.” ▶



High-spec Gabriel is aimed at training market

Blackshape



From yuckspeak to tales of yore, send your offcuts to murdo.morrison@flightglobal.com

Saving the last Beverley

The last Blackburn B-101 Beverley – a 1950s UK Royal Air Force transporter with a hull capable of carrying 90 troops – has been saved by benefactors, 46 years after its final flight.

XB259 had been part of the display at Fort Paull, a former gun battery and heritage centre on the Humber, since 2003. However, the site's closure this year threatened its future.

The plan is for the Beverley – a former test example and the only survivor of 49 built at Brough between 1952 and 1958 – to live out its days at Birchwood Lodge, a private airfield in Yorkshire, close to the original factory.

However, Martyn Wiseman, managing director of Condor Aviation, who with an anonymous colleague bought the four-engined Bristol Centaurus-powered aircraft, now needs to raise £100,000 (\$132,000) to dismantle it and carry it to its new home, where it will be the centerpiece of a larger exhibit.

"The Blackburn has an esteemed history, and as a fan of radial engine aircraft, I couldn't bear to see this go the same way as all the others," he says.

But with an almost 50m (164ft) wingspan and "a fuselage so large you can fit a single-decker bus inside" it will be an engineering feat to move it, he admits.

If you want to help, contact Wiseman at condoraviation.co.uk

Smoke in your skies

From Canada, a campfire tale concerning a Delta Air Lines Airbus A330-300 whose pilots and cabin crew noted the smell of "wood smoke" while in cruise for London on 22 October.



Moving the last B-101 Beverley transporter won't be an easy task

According to the Transportation Safety Board of Canada, the crew declared an emergency and began to commence a descent.

Although they consulted the quick-reference handbook for the fumes procedure, the odour did not dissipate, and the pilots diverted to land at St John's in Newfoundland.

No failures or faults were recorded by the aircraft's systems, and a quick inspection confirmed there was no-one from Quebec stowing – or burning – timber on the deck.

But there has been a fair amount of wood blazing over in Colorado, the scene of recent wildfires, and investigators reckon the crew detected the distinctive scent after it was carried aloft to high-altitude eastern Canadian airspace.

Smokey Bear says: "Only you can prevent someone's in-flight movie being interrupted."

From the archive

100

1921 Badge of honour

The Royal Air Force is to have its own ensign, the design of which has been approved by His Majesty. It consists of a flag of R.A.F. blue, having the Union flag in the upper canton next the staff, as in all British national ensigns. The "fly" bears the circular identification mark borne by British Service aircraft, so familiar a sight during the War. There is to us a double significance in this grant of a distinctive ensign to the Royal Air Force. Not only does it convey a sense of honour worthily earned, but it signifies also the separateness, if we may call it so, from the sister services of the Royal Air Force, and stamps it as one distinct in its duties and its very element from both Navy and Army, though owing allegiance to a single ideal and devoted to a common task.

75

1946 Pioneering vision

January 11th, 1946, is destined to become one of the red-letter dates in the history of the Royal Aeronautical Society, not merely because it was the eightieth birthday of the Society (actually the first meeting of the council was held on January 12th, 1866) but because the anniversary dinner was held in London's ancient Guildhall, an honour which, as Sir Frederick Handley Page pointed out, was appropriate as well as highly valued. The founders of the R.Ae.S., as the Minister of Supply and Aircraft Production so aptly expressed it, were farsighted to a remarkable degree. But a few years after the first run of Stephenson's "Rocket," they began to ponder the next step, the problems of getting into the air, which must have appeared to them almost insuperable.



Speed reading

Aviation writer Andreas Spaeth is hoping to find an English-language publisher for his new book (in German) on supersonic airliners – the first, he claims, to cover all aspects of faster-than-sound initiatives, from Concorde and the American and Soviet efforts in the 1960s to the likes of Aerion and Boom in the 2020s.

The tome includes several rare images, including of the Boeing SST, as well as *Flight International's* very own cover from 2003 marking the final commercial flight of Concorde.

To order a copy, in German, go to the Motorbuch Versand website, where it is priced at €29.90.



FlySafair unmasked

You have to sympathise with South African carrier FlySafair which, under budget pressures caused by coronavirus, repurposed one of its broadcast adverts because it couldn't afford to film an entirely new one.

This hasn't gone down well with the Advertising Regulatory Board. It acknowledges that scenes of aircraft boarding have been updated to feature passengers and cabin crew wearing the necessary pandemic paraphernalia, but points out that re-used



footage – with cocktail-partygoers shown mask- and glove-free – conveys the wrong impression.

"The failure to show masks in subsequent scenes... may imply to some viewers that, once you are on holiday, the rules no longer apply," the board ruled on 23 October.

FlySafair's explanation that the costs to reshoot the advert were "prohibitive",

and that it inserted disclaimers and scenes where mask-wearing is not enforced, didn't sufficiently move the regulator, which has ordered the advert's withdrawal. "It was too expensive" is not a defence," it says. Harsh.

1971 Jumbo paypacket

Following talks which began in July 1969, and a dispute which has kept BOAC's 747s on the ground for nearly a year (they have not yet entered service), the corporation and its pilots have agreed rates for flying the Boeing 747. Senior captains on all types will receive £9,000 a year, which represents a rise of about £400 on their previous maximum possible salary. The first BOAC services to New York with the 747 should now begin twice weekly in April, with daily flights beginning in May. The airline will take delivery of its second batch of three 747s shortly, with two due to arrive in February and one in March. They will be flown initially with three-pilot crews, but BOAC and Balpa have agreed to carry out an evaluation aimed at achieving two-pilot operation by the late autumn.

50

25

1996 Blinded by the light

Hotel and casino operators in Las Vegas have been ordered to suspend their laser displays following an incident involving a Southwest Airlines Boeing 737 first officer being temporarily blinded by a burst of laser light. The incident, which took place on 30 October, 1995, happened as the 737 was passing through 7,000ft (2,000m) in a right turnout after leaving Las Vegas McCarran Airport. The first officer, who was flying the aircraft at the time, was "unable to see for about 2min" because of the light. Following an investigation by the FAA and the US Food and Drug Administration (which licenses the lasers), operators have been ordered to suspend their use temporarily, pending the establishment of new aiming, beam dispersion and power-output guidelines.

Letters



Chris Kemp/Shutterstock

Plane-spotting, 2020-style

Early warning

With reference to your recent De Havilland competition question about the Comet spawning the Nimrod (*Flight International*, November 2020): when I was working at Woodford to put the support in place for the ill-fated airborne early warning Nimrod, we discovered that the Nimrod crash switches were originally used on the Avro Lancaster!

Mike Parker

Preston, Lancashire, UK

Essential reading

When sorting out my magazine library, this *Flight International* issue dated 30 August 1980 was there – its article on the Farnborough air show was the reason that we



We welcome your letters about our coverage, or any other aerospace-related topic. Please email flight.international@flightglobal.com, or write to: The Editor, Flight International, 1st Floor, Chancery House, St Nicholas Way, Sutton, Surrey, SM1 1JB. Letters should be no longer than 350 words in length, and supplied with the correspondent's name and location. Letters may also be published on FlightGlobal.com, and do not necessarily represent the views of the editor.

Deja vu?

The current sad sight of stored aircraft, and airliners being used for sightseeing flights or on-the-ground dining (*Flight International*, November 2020), prompted memories of my childhood in London and my Dad taking me for a pleasure flight from London Airport – as Heathrow was known then – in a Dragon Rapide.

During the circuit we passed over a line of recently-grounded Comet 1s and I recall the emotional voice of the pilot describing his concerns for the future of British civil aviation.

Another memory was of a flight in an Auster over the Solent and seeing the Saunders-Roe Princess flying boat on the slipway below. Now my local airfield of Hurn (Bournemouth International) has its own long line of grounded Airbuses.

Chris Coates

Poole, Dorset, UK

visited the event some years later, and it was fantastic.

I paid a whopping NZ\$2.35 for the magazine, and it was worth every cent.

I still cannot get over an article in it about a TriStar incident with an in-flight fire that killed all 300 on board, owing to two butane gas cookers. The article states that “Camping stoves are known to have been carried (and occasionally used in cabin aisles)” on some flights.

Can you imagine that happening today? You would not get those things on board, let alone use them.

George Empson

Lake Tekapo, New Zealand

Festive humbug

I'm perplexed that Uncle Roger's Christmas quiz has mysteriously disappeared, to be replaced by a 'Festive' quiz (*Flight International*, December 2020).

What exactly are we feasting about, if not the birth of Christ 2020 years ago? Is this some do-gooder's attempt at not offending

somebody somewhere in your audience? Have you actually had complaints about the use of the term 'Christmas' with all its shocking connotations, of peace on Earth, goodwill to all mankind and the birth of a Saviour?

I trust that with this discarding, and to avoid hypocrisy, you have decided to forego the proffered bank holidays and other trimmings, and will be working straight through with no festivities allowed.

Poor show. Uncle Roger would surely be horrified.

via email

Editor's reply: Oh dear – perhaps this outrage was prompted by narrowly missing out on getting that treasured Total Aviation Person score in our fiendish annual quiz? There is no do-goodery occurring here: our use of the term 'Festive' reflects the fact that the quiz questions are not Christmas-themed, and has been used by us for many years with this feature. More seasonal cheer next time, please, or you might end up on Uncle Roger's naughty list! Now, where did we put the sherry...

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Biman BANGLADESH AIRLINES

**Biman Bangladesh Airlines Limited
Ministry of Civil Aviation and Tourism, Dhaka
Request for Expression of Interest (REOI)**

No: 30.34.0000.012.048.20

Subject: Procurement of Consulting services for Establishing Passenger Service System (PSS), Departure Control System (DCS), Global Distribution System, e-Commerce, Loyalty and associated services for Biman Bangladesh Airlines under package no: 001

Biman Bangladesh Airlines is the flag carrier of Bangladesh and is in the business of air transportation of passengers, cargo and related activities, hereby invites prospective Solution Providers/ Consultants to indicate their interest in providing Passenger Service System (PSS), Departure Control System (DCS), Global Distribution System, e-Commerce, Loyalty and associated services for Biman Bangladesh Airlines. The consultancy services include- Passenger Service System (PSS),

To provide above mentioned services, a brief update on Biman Bangladesh Airlines and required services is available in detail REOI in the website (www.biman-airlines.com). Services will be further defined or detailed out in Request for Proposal (RFP). Only shortlisted Applicants will get the opportunity to submit the proposal based on RFP.

SCOPE OF WORK:

Biman is seeking a Cloud based PSS solution with data storage and processing system should be elastic, where the Solution Provider takes on responsibility for delivering the services as defined in this document to inside and outside users for the Biman Bangladesh Airlines Ltd. Biman users include, but are not limited to the below services related to passengers booking, reservation agents, travel agents (accredited and non-accredited), tour operators and corporate customers, airport agents, third- party ground-handlers, staff, contractors, airline partners and GDS subscribers.

The consultancy services include- Passenger Service System (PSS), Departure Control System (DCS), Global Distribution Systems (GDS), E-Commerce, Loyalty and other associated services.

Passenger Service System (PSS):

To opt for a next-generation PSS built on the latest services-oriented architecture and agile technologies, aligned with the needs of the modern era of smart devices.

Departure Control System (DCS):

Detailed and upgraded DCS function with Baggage Reconciliation and Weight and Balance system including Load control.

Global Distribution System:

The system must have their GDS having connectivity with leading GDS.

E-Commerce, Loyalty & Associated Services:

E-Commerce- Internet Booking Engine, Travel Agent Portal, Shopping & Merchandising Engine, API's, M-Commerce-Mobile App, FFP-Loyalty Engine, Campaign & Promotion, Meta Search Engine Support & Reporting, Ancillary Sales etc.

MIGRATION:

Information required in this section will include a description of solution provider's proposed migration milestones and timelines, activities, bidder and Biman people involved in the project, etc. Capable to work with Technical Team of SITA (Existing Biman Host System.) for Data Migration and experience on Data Migration.

IT Infrastructure:

Biman is looking for complete transparency around integration services, network or web hosting services if required to successfully implement the proposed PSS solution. Solution Provider is also required to describe their Business Continuity and Disaster Recovery program in this section.

Solution Providers Eligibility, Capability, Experience and Biman's other Requirements:

Company History, Financial Reports, Strategies & Plans:

- Brief history of the solution provider/consultant with information on Manpower along-with technical and professional competencies for successful implementation of the services.
- Organization's profile and financial reports for the past three years counting backward from the date of publication of this REOI.

Date: 31st December' 2020

- Solution Provider shall mention his current capacity to handle passengers on Board (PB) in terms of number of passengers per each Airline Annually including LCC and Full-Service carriers.
- Organization's future plans in Research & Development and innovation for the travel and tourism industry.
- List of Passenger Services System, Departure Control System operational application modules of the Solution Provider/consultant.
- An overall functional model and a brief description of the functionality of required all services.

Interested Solution Providers/ Consultant should provide information demonstrating that they have the required qualifications and relevant experience to perform the Services.

Mandatory criteria for shortlisting:

- Interested applicants/solution provider shall have to apply/submit the EOI individually.
 - Applicant shall demonstrate financial capacity by submitting last 3 years financial audit report till last February 2020 with average annual turnover minimum USD 30 Million.
 - Lead Solution provider/consultant shall be capable to provide all required services (PSS, DCS, GDS, E-Commerce and Loyalty) services through an integrated system.
 - The Solution provider shall have minimum 10 (Ten) years' experience in each of Passenger Service System (PSS), Departure Control System (DCS), Global Distribution System (GDS), E-Commerce, Loyalty and Associated services for aviation industry.
 - The Solution provider shall have minimum 25 including 05 (Five) full-service carrier experience who has been using all or part of the solution proposed in this REOI. List of the present customer Airlines with provided services, to be attached with the proposal.
 - The Solution provider shall have capability of Bi-lateral Interline E-ticket and all type of Code-share Partnership agreement and capability to integrate with any Interline Partner's Host system.
 - The Solution provider shall have IATA NDC Level-04 either capable or certified as either IT Provider or Aggregator.
 - The Solution provider shall have at least 03 (three) Commercial Airline's PSS & DCS migration experience.
 - The Solution provider shall have 24 X 7 customer Technical support service globally and have the capability to establish an appropriate office in Bangladesh for facilitating all services mentioned in REOI, if awarded the contract finally.
- The procurement will follow the Quality and Cost Based selection (QCBS) method as per Public procurement act 2006 and Public procurement rules 2008 of the Government of Bangladesh. Interested Solution providers/consultants need to sign a Non-Disclosure Agreement (NDA) with Biman. Interested Solution providers are requested to submit signed NDA, to the e-mail ID: dmsbiman@bdbiman.com and gmmarketing@bdbiman.com latest by **1700 Bangladesh time on 21st January 2021**. Expression of Interest (EOI) must be submitted within Bangladesh Time **5pm by 21st January 2021** either in sealed envelope through courier service to the address below or e-mail to dmsbiman@bdbiman.com and gmmarketing@bdbiman.com with clearly marked "EOI for Establishing Passenger Service System (PSS), Departure Control System (DCS), Global Distribution System (GDS), e-Commerce, Loyalty and associated services for Biman Bangladesh Airlines. Late submission shall not be accepted and returned unopened. Biman Management reserves the right to accept or reject any or all EoI without assigning any reason whatsoever at any stage. This REOI along with detailed REOI and NDA are available at www.biman-airlines.com.
- Further information or any queries can be obtained at the address below during office hours: 0900 to 1700 hours (Sunday to Thursday).
- Md. Shawkat Hossain, Director Marketing & Sales, Biman Bangladesh Airlines. Head office, Balaka Bhavan, Kurmitola, Dhaka-1229, Bangladesh. Phone No.: +88-02-8901350. Cell No.: +88-01777715504. Email: dmsbiman@bdbiman.com**

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Offers are invited by the International Committee of the Red Cross (ICRC) from established companies holding AOC for Wet Lease-in of following aircraft types and locations.

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Nigeria

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Republic of South Sudan

Republic of South Sudan

Aircraft Type

2 Beechcraft 1900D
1 Beechcraft 1900D
2 Dash-8 (106 & 102), or
1 Dash-8 (106) and 1 B1900D
1 Dornier 228
1 Dash8 (106) or 1 Embraer 135
1 LET410 UVP E20
1 LET410 UVP E20
1 Beechcraft 1900D or 1 Dash-8
1 Beechcraft 1900D or 1 Dash-8
1 Bell 412 (or similar)
1 Beechcraft 1900D
3 Twin Otter DHC6
2 Bell 412 (or similar)
1 Buffalo DHC-5

The successful companies will operate under the ICRC time charter agreement, ICRC SOP, brand name "The International Committee of the Red Cross" and with its call sign "RED CROSS". The proposed aircraft(s) are to be introduced from April 2021 latest.

Closing date for submissions: **Monday 1st February 2021 12:00 Geneva local time**

The ICRC reserves the right to accept or reject any or all of the offer(s) at any time and/or stage without assigning any reason whatsoever. Offers from agents/brokers will not be entertained.

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Interviews for successful applicants will be held in London in early December 2020.

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- Initial 3 year contract
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Available roles

Senior Quality Assurance Engineer x 1

- Minimum of 15 years in the industry with a certifying staff background
- Minimum of 3 years working experience in a quality system e.g.Q-Pulse
- EASA Part 66 B1 / B2
- Formal training on audit techniques and experience in auditing
- Good working knowledge of current regulations such as Part 145, Part M, Part 21J

Licensed Aircraft Engineer Avionics x 1

- Minimum of 10 years in the industry
- Minimum of 3 years as a certifying engineer, preferably with Sikorsky and Boeing aircraft.
- EASA Part 66 B2
- Working knowledge of EASA and/or EASA based regulations

Licensed Aircraft Engineer Rotary Wing x 3

- Minimum of 10 years in the industry
- Minimum of 3 years as a certifying engineer, preferably with Sikorsky aircraft.
- EASA Part 66 B1-3
- Working knowledge of EASA and/or EASA based regulations

Logistics Manager x 1

- Minimum of 15 years in the industry
- Minimum of 5 years in a logistics managerial position
- Relevant training for goods inwards / dangerous goods and Human Factors
- Working knowledge of EASA and/or EASA based regulations

Logistics Controller x 1

- Minimum five years in the industry or equivalent experience
- Holding a goods inwards authorisation
- Preferably holding dangerous goods authorisation
- Working knowledge of EASA and/or EASA based regulations

Technical Records / Library Supervisor x 1

- Minimum of 10 years in the industry
- Relevant experience in the registering of technical /airworthiness publications and data
- Familiarity with Rusada Envision or similar maintenance data base would be advantageous
- Working knowledge of EASA and/or EASA based regulations

For those individuals who are interested, please apply by submitting a CV (with personal details) via email at **recruitment@hmsf.gov.bn** quoting the relevant position

Teara Fraser, founder and chief executive of the first indigenous-woman-owned airline, tells the story of how earning her wings helped her connect to the land of her ancestors in Canada's Arctic region

North star

Pilar Wolfsteller Las Vegas

In October 2001, Teara Fraser, a Canadian single mother of two, stepped out of her comfort zone and into a small aircraft for the first time.

Within minutes, the trajectory of her life fundamentally changed.

"All of a sudden I could witness the land from the air, like a bird," she says. "I told myself: 'I don't care what it takes to make this happen. I'm going to fly airplanes.'"

Within a year, Fraser was a certified commercial pilot, and began flying passengers in northern British Columbia. She was a young indigenous woman aiming high in a white man's industry.

"Like most pilots, I had that dream of flying the big iron," she says. "I thought that the bigger the bird I could fly, the more I have arrived."

Born in Canada's Northwest Territories, the 49-year-old calls herself "a proud Métis woman" – a member of an indigenous group with a distinct collective identity, customs and way of life. In 2020, she was named one of Canada's "Top 25 Women of Influence".

She has arrived, but in ways she never imagined.

Fraser never went on to fly the big iron. With time, the dream shifted to a different, more-difficult path.

In 2010, she became an entrepreneur, founding an aerial survey company, which allowed her to combine two things she loved dearly: aviation and the land of her ancestors. After six years she sold the business and was on the verge of hanging up her wings.

"My wings literally gave me wings for everything else I did in my life," she says. "But being in this industry is hard, it's so tiring."

In the process of letting go, a rebirth happened.

"I began to imagine an industry that was different from the one that I was in – an industry that welcomed and respected matriarchal leadership," she says. "What would be possible in an industry where there is true diversity?"

"And so then I began to think about how I create that for myself."

In 2019 she launched Iskwew Air, an air charter company that serves remote indigenous communities across British Columbia and its neighbouring provinces and territories. "Iskwew" (pronounced "iss-kway-yo") is the word for "woman" in the indigenous Cree language.

She chose the name partly because her company is the first indigenous-woman-owned airline. But it also celebrates broader achievements of women everywhere, she says, and efforts by those working to achieve gender equity.

Iskwew Air, based at Vancouver International airport, ferries goods and people throughout the vast, sparsely populated region in an eight-passenger, twin-engined Piper PA-31 Navajo Chieftain. Fraser has christened her aircraft "The Sweetgrass Warrior".

"You have gifts, and you have knowledge, and it is our responsibility to share those," she says. "So, for me, it was about: how can I take what I've learned and do good with it? How can I serve and uplift indigenous communities?"

"We need to think about reciprocity with the land and how we walk gently on our Mother Earth"

The airline has continued operating through the coronavirus crisis, bringing urgently needed aid to far-flung towns and villages – places that often rely on air bridges to connect them to other population centres.

Iskwew is a member of the new Canadian Advanced Air Mobility Consortium (CAAM), a multi-stakeholder group committed to developing and building the sector in Canada.

"We want to be part of the ecosystem that is co-creating the next frontier of sustainable air transportation, bringing innovative technology solutions to serve social, ecological and environmental justice. The consortium is looking at equity as a core part of the model of rebuilding the air transportation system."

"We need airplanes," she says. "But we also need to be really thinking about reciprocity with the land and how we walk more gently on our Mother Earth." And in so doing, she hopes to be part of the solution that will "honour, uplift and energise [the] indigenous land story, sovereignty and stewardship".



Rob Krueyt

Teara Fraser heads Iskwew Air, a Vancouver-based charter company

Fraser hopes to pass her passion for aviation to young people, but at the same time takes the industry to task for its lack of diversity, and advocates for improved minority representation.

"Indigenous youth are the fastest-growing demographic in our country. They are smart, resilient, creative, innovative, and grounded. They bring a new, much-needed perspective," she says, adding that industry leaders must realise they are better served with increased diversity of worldview and wisdom.

And to the young people, she advises diligence. Specialised scientific knowledge, like maths or physics,

is important, but that is not going to make someone the best at something.

Even more vital than the subject matter is, as she puts it, "to show up with intention".

"The technical stuff can be taught," she says. "To be a pilot, you need to care about people and safeguard the wellbeing of others. You need to act with integrity and honesty, hold yourself to a high level of capability and accountability."

"I started my own company because I want to be able to show up as my whole self proudly, and I want that for everyone in our industry." ▶



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The Fund an Angel Virtual Auction raised significant funds in support of Corporate Angel Network (CAN). Proceeds from the event will ensure CAN is able to continue helping cancer patients, like Scarlett, in critical need during the pandemic and long after. Thank you to all who generously contributed.



Scarlett, an immune compromised pediatric cancer patient, was in need of transportation to a specialized treatment center. CAN was able to transport the family just before Scarlett's 5th birthday.

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